REVISED EDITION

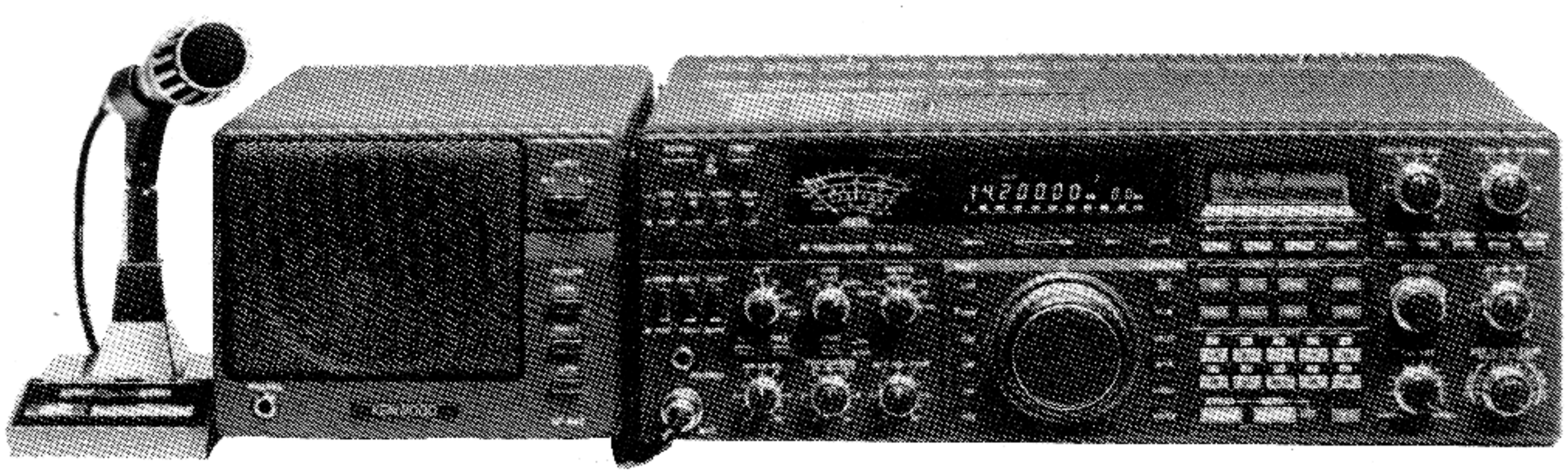
KENWOOD

# SERVICE MANUAL

# TS-940S

## SP-940, AT-940, SO-1, VS-1

## HF TRANSCEIVER



## CONTENTS


CIRCUIT DESCRIPTION . . . . . 2
SEMICONDUCTOR DATA . . . . . 35
PARTS LIST . . . . . 43
DISASSEMBLY . . . . . 62
PACKING . . . . . 66
ADJUSTMENT . . . . . 67
LEVEL DIAGRAM . . . . . 82
TERMINAL FUNCTION . . . . . 83
PC BOARD VIEWS/CIRCUIT DIAGRAMS
- RF UNIT (X44-1660-00) . . . . . 90
- 100W FINAL UNIT (X45-1400-00) . . . . . 90
- LPF UNIT (X51-1330-00) . . . . . 90
- IF UNIT (X48-1430-00) . . . . . 92
- CONTROL UNIT (X53-1420-11) . . . . . 94
- PLL UNIT (X50-2020-00) . . . . . 96
- CAR UNIT (X54-1840-00) (A/2) . . . . . 96
- AT UNIT (X57-1130-00) . . . . . 98
- DIGITAL A UNIT (X54-1830-00) . . . . . 100
- DIGITAL B UNIT (X54-1840-00) (B/2) . . . . . 100
- DIGITAL C UNIT (X54-1850-00) . . . . . 100
- SW UNIT (P) (J25-3356-04) . . . . . 100
- SW UNIT (X41-1600-00) . . . . . 102
- AVR UNIT (X43-1500-00) . . . . . 102
- DC-DC UNIT (X46-1030-00) . . . . . 102
- RIT ENCODER UNIT (X54-1690-01) . . . . . 102
- MAIN ENCODER ASS'Y (W02-0328-10) . . . . . 102

SCHEMATIC DIAGRAM . . . . . 103
AT-940 (ANTENNA TUNER) . . . . . 104
SO-1 (STANDARD OSCILLATOR UNIT) . . . . . 104
SP-940 (SPEAKER) . . . . . 104
VS-1 (VOICE SYNTHESIZER UNIT) . . . . . 106
BLOCK DIAGRAM . . . . . 107
SPECIFICATIONS . . . . . BACK COVER



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# TS-940S SPECIFICATIONS

## [General]

**Transmitter Frequency :**
**Range** . . . . . 160m Band 1.8–2.0MHz
80m Band 3.5–4.0MHz
40m Band 7.0–7.3MHz
30m Band 10.1–10.15MHz (10.0MHz WWV)
20m Band 14.0–14.35MHz
17m Band 18.068–18.168MHz
15m Band 21.0–21.45MHz
12m Band 24.89–24.99MHz
10m Band 28.0–29.7MHz

**Receiver Frequency :**
**Range** . . . . . 150kHz–30MHz
**Mode** . . . . . A3J (USB, LSB), A1 (CW), F1 (FSK), A3 (AM), F3 (FM)
**Frequency Stability** . . . . . ±10 x $10^{-6}$ (0°C–+50°C)

**Antenna Impedance with AT-940 antenna tuner** . . . 50Ω
20–150Ω (Transmission only)
**Power Requirement** . . . . . 120/220/240 VAC, 50/60Hz
**Power dissipation** . . . . . Max. 510W during transmission, 80W during reception
**Grounding** . . . . . Negative
**Dimensions** . . . . . W401 x H141 x D350mm
W409 x H154 x D420mm (Projections Inc.)
W160.4 x H56.4 x D140 inch
W163.6 x H61.6 x D168 inch (Projections Inc.)
**Weight** . . . . . With antenna tuner : Approx. 20kg
Without antenna tuner : Approx. 18.5kg

## [Transmitter]

**Rated Final Power Input** . . . . . 250W (160–15m bands in SSB, CW, FSK, FM)
250W (10m Band in SSB, CW, FSK, FM)
140W (in AM)
**Modulation** . . . . . SSB : Balanced, FM : Reactance, AM : Low level
**Maximum Frequency Deviation** . . . . . ±5kHz
**RTTY Shift** . . . . . 170Hz
**Carrier Suppression** . . . . . –40dB or less (in CW)
**Unwanted Sideband Suppression** . . . . . Better than 50dB (with 1.5kHz modulation)
**Third Harmonic Modulation Distortion** . . . . . –31dB or less (based on single tone output)
**Microphone Impedance** . . . . . 500Ω–50kΩ
**Frequency Response** . . . . . 400–2600Hz at –6dB in SSB

## [Receiver]

**Circuitry** . . . . . Quadruple conversion for SSB, CW, AM, FSK, Triple conversion for FM
**Intermediate Frequencies** . . . . . 1st IF : 45.05MHz, 2nd IF : 8.83MHz
3rd IF : 455kHz, 4th IF : 100kHz

**Sensitivity :**
**150kHz–500kHz** . . . . . 10dB S/N 10dBμ (1μV) or less in SSB, CW and FSK
10dB S/N 10dBμ (10μV) or less
**500kHz–1.8MHz** . . . . . 10dB S/N 12dBμ (4μV) or less in SSB, CW and FSK
10dB S/N 30dBμ (32μV) or less in AM
**1.8MHz–30MHz** . . . . . 10dB S/N –14dBμ (0.2μV) or less in SSB, CW and FSK
10dB S/N 6dBμ (2μV) or less in AM
12dB SINAD –6dBμ (0.5μV) or less in FM
**Squelch Sensitivity** . . . . . –10dBμ (0.32μV) or less
**Image Ratio** . . . . . 80dB or more in 1.8–30MHz
**IF Rejection** . . . . . 70dB or more in 1.8–30MHz
**Selectivity :**
**(SSB, CW, AM (N), FSK)** . . . . . 2.4kHz or more/–6dB, 3.6kHz or less/–60dB
**(AM (W))** . . . . . –6kHz or more/–6dB, 18kHz or less/–50dB
**(FM)** . . . . . 12kHz or more/–6dB, 24kHz or less/–60dB

**Variable Range with SSB filter :**
**(SSB Slope Tune)** . . . . . High-cut : 1500Hz or more, Low -cut : 700Hz or more without SSB filter
**(CW VBT)** . . . . . 600Hz–2.4kHz variable continuously
**RIT/XIT Variable Range** . . . . . ±9.99kHz
**Notch Filter Attenation** . . . . . 40dB or more
**Audio Output** . . . . . 1.5W (at 8 ohm load/10% distortion)
**Audio load Impedance** . . . . . 8 ohms

**Note :** Circuits and ratings subject to change without notice due to developments in technology.

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# CIRCUIT DESCRIPTION

| Item \ Model | TS-940S | | | | | | | | TS-94X | | REF' |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DISTINATION | K1 | K2 | M1 | M2 | T1 | T2 | W1 | W2 | X1 | X2 | |
| CODE | 11 | 12 | 21 | 22 | 51 | 52 | 61 | 62 | 71 | 72 | |
| AT-940 | W | W/O | W | W/O | W | W/O | W | W/O | W | W/O | W : with, W/O : without |
| AC INPUT | 120V | | 220V | | 240V | | 220V | | 240V | | Selectable. 120–220–240V |
| BRAND NAME | KENWOOD | | | | TRIO | | KENWOOD | | | | |

**Note :** 1) K1;K2 : USA M1,M2 : General T1,T2 : United Kingdom W1,W2 : Europe X1,X2 : Australia/Newzealand

**Table 1**

## Frequency configuration

The TS-940 is quadruple conversion in SSB, CW, AM and FSK modes and triple conversion in FM mode. As a transmitter, it is double conversion in CW and FM modes and triple conversion in SSB, AM and FSK modes.

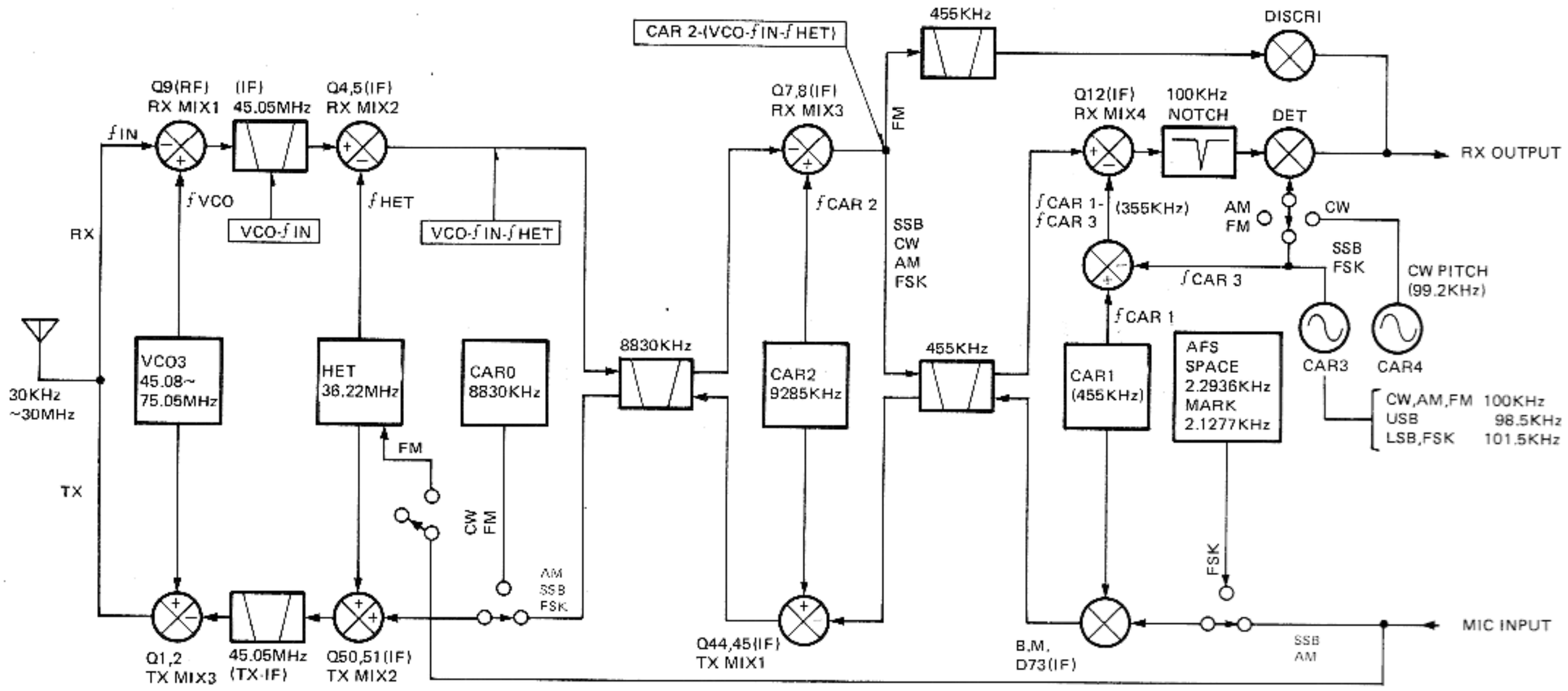


**Fig. 1 TS-940S signal channel**

**Fig. 1** shows the frequency configuration of the signal channels as both a transmitter and a receiver. The receiver frequency in SSB mode will be described now. It is assumed that the input frequency entered from the antenna is fIN' the local oscillator input of RX MIX1 is fVCC' the local oscillator input of RX MIX2 is fHET' the local oscillator input of RX MIX3 is fCAR2 and the local oscillator input of RX MIX4 is fCAR1 – fCAR3.

When the receiver output tone frequency by fIN is zerc beat (namely, at zero to the SSB signal with a carrier point of fIN), the relationship between these signals is expressed by the following equation.

$$\left[f_{CAR2} - \left\{\underbrace{(f_{VCO} - f_{IN})}_{MIX1} - f_{HET}\right\}\right] - (f_{CAR1} - f_{CAR3}) = f_{CAR3}$$

MIX2

MIX3

MIX4

# CIRCUIT DESCRIPTION

The equation is arranged as follows.

$$fIN = fVCO - fHET + fCAR1 - fCAR2 \quad \cdots\cdots\cdots (1)$$

The term fCAR3 is eliminated as it is not related to the receiver frequency itself. As for the remaining terms, all are generated in the PLL (Phase Locked Loop) circuit in the configuration shown in **Fig. 2**. The frequencies generated are now examined for each loop.

In VCO0 $\quad \dfrac{f_{VCO0}}{N0} = \dfrac{\frac{1}{2} \cdot f_{STD}}{500}$

$$\therefore f_{VCO0} = \frac{N0}{1000} \cdot f_{STD} \quad \cdots\cdots (2)$$

In VCO1 $\quad \dfrac{f_{VCO1}}{N1} = \dfrac{\frac{1}{4} \cdot f_{STD}}{500}$

$$\therefore f_{VCO1} = \frac{N1}{2000} \cdot f_{STD} \quad \cdots\cdots (3)$$

In VCO2 $\quad \dfrac{f_{VCO2} + \frac{f_{VCO4} + f_{VCO5}}{10} - \frac{f_{VCO1}}{100}}{N2} = \dfrac{\frac{1}{2} \cdot f_{STD}}{500}$

$$\therefore f_{VCO2} = \frac{N2}{1000} \cdot f_{STD} + \frac{f_{VCO1}}{100} - \frac{f_{VCO4}}{10} - \frac{f_{VCO5}}{10} \quad \cdots\cdots (4)$$

In VCO3 $\quad \dfrac{\frac{f_{VCO2}}{10} + f_{STD} + 3 \cdot f_{STD} - f_{VCO3}}{N3} = \dfrac{\frac{1}{2} \cdot f_{STD}}{20}$

$$\therefore f_{VCO3} = \frac{160 - N3}{40} \cdot f_{STD} + \frac{f_{VCO2}}{10} \quad \cdots\cdots (5)$$

In VCO4 $\quad \dfrac{f_{VCO4}}{N4} = \dfrac{f_{CP}}{1800}$

$$\therefore f_{VCO4} = \frac{N4}{1800} \cdot f_{CP} \quad \cdots\cdots (6)$$

In VCO5 $\quad \dfrac{f_{VCO5}}{N5} = \dfrac{f_{VB}}{1800}$

$$\therefore f_{VCO5} = \frac{N5}{1800} \cdot f_{VB} \quad \cdots\cdots (7)$$

The above equations are thusly arranged so the frequencies of each local oscillator are expressed as follows.

$$f_{VCO} = \left(\frac{160 - N3}{40} + \frac{N2}{10000} + \frac{N1}{2000000}\right) f_{STD} - \frac{N4}{180000} \cdot f_{CP} - \frac{N5}{180000} \cdot f_{VB} \quad \cdots\cdots (8)$$

$$f_{HET} = f_{VCO0} = \frac{N0}{1000} \cdot f_{STD} \quad \cdots\cdots (9)$$

$$f_{CAR1} = \frac{1}{100} \cdot f_{VCO4} = \frac{N4}{180000} \cdot f_{CP} \quad \cdots\cdots (10)$$

$$f_{CAR2} = \frac{1}{2} \cdot f_{STD} - \frac{1}{100} \cdot f_{VCO5} = \frac{1}{2} \cdot f_{STD} - \frac{N5}{180000} \cdot f_{VB} \quad \cdots\cdots (11)$$

$$f_{CAR3} = f_{CAR2} - f_{CAR1}$$

$$= \frac{1}{2} \cdot f_{STD} - \frac{N5}{180000} \cdot f_{VB} - \frac{N4}{180000} \cdot f_{CP} \quad \cdots\cdots (12)$$

Therefore, the term "fIN" of equation (1) is re-written as follows.

$$f_{IN} = \left(\frac{160 - N3}{40} + \frac{N2}{10000} + \frac{N1}{2000000} - \frac{N0}{1000}\right) \cdot f_{STD} \quad \cdots\cdots (13)$$

As shown in equation (13), the receiver frequency is determined only by the reference fSTD and the dividing ratio N0—N3. This shows the following.

1. N is the numeric value determined by the microprocessor in accordance with the operating frequency and, essentially, does not include an error component.
2. With the primary term of fSTD only, the reference frequency accuracy is directly considered as an operating frequency accuracy.
3. The operating frequency does not change even if N4, N5, fCP and fVB change.

The accuracy of the reference crystal oscillator used in the TS-940 is 10PPM (-10 ~ +50°C). It is 0.5PPM (-10 ~ + 50°C) when the optional TCXO (Temperature Compensated Crystal Oscillator) S0-1 is used.
According to 1 and 2, the overall accuracy of the TS-940 is highly stable with the same value as described above obtainable at any point in the 30kHz-30MHz range. Utilizing the characteristic of 3 above, the TS-940 has variable bandwidth functions such as VBT and slope tuning controlled by the microprocessor, which operates N4 and N5. At the same time, the TS-940 sets the carrier point by making fine adjustment of fCP and adjusts the initial setting of VBT by making fine adjustment of fVB.

# CIRCUIT DESCRIPTION

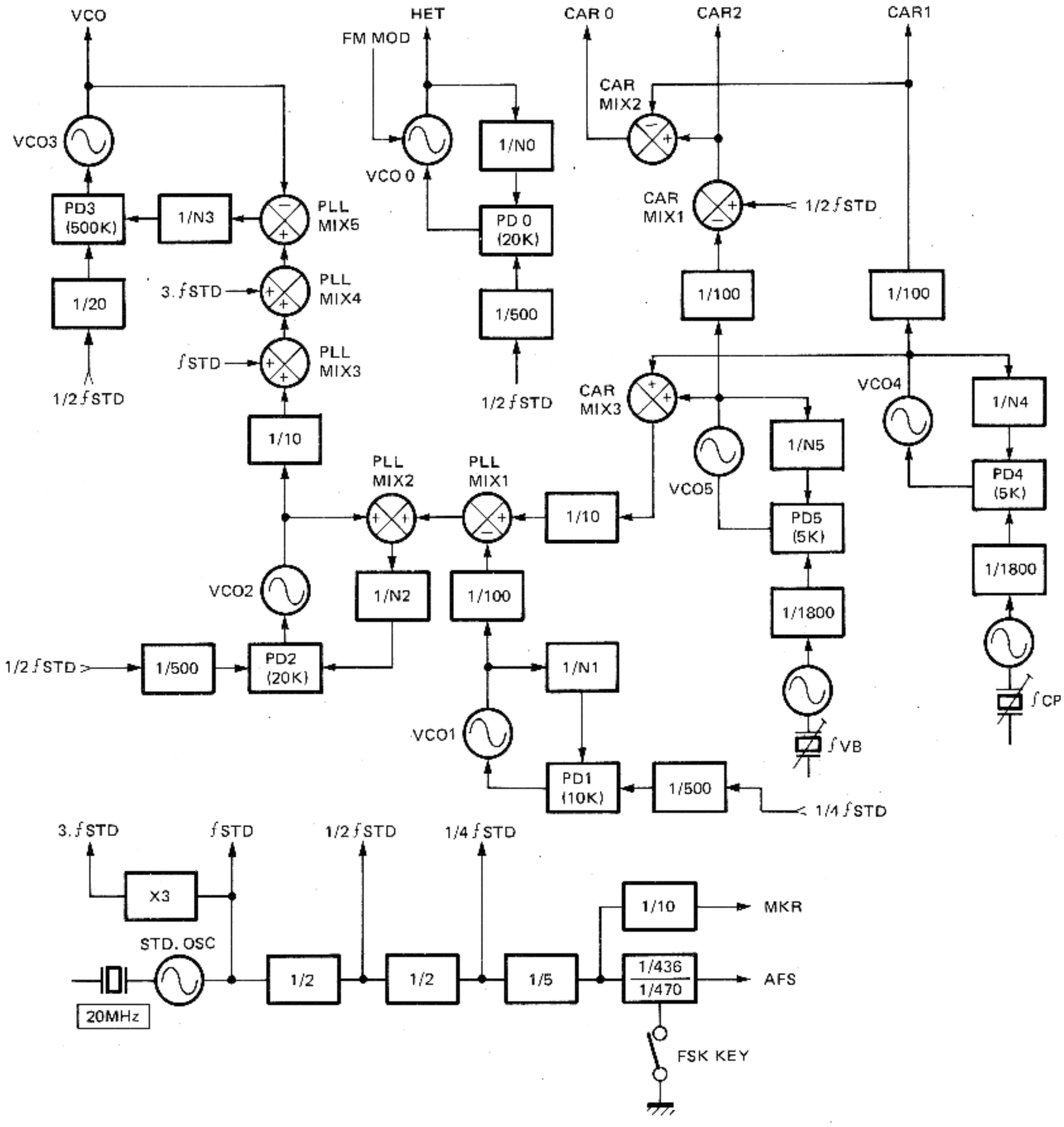


**Fig. 2 TS-940S PLL channel**

The receiver frequency in SSB mode has been described. In other modes or when used as a transmitter, likewise, the frequency is determined by the reference fSTD and dividing ratio.
The display frequencies are as shown in the following table.

| | |
|---|---|
| USB, LSB | Carrier point frequency |
| CW | Transmission carrier frequency |
| AM, FM | IF filter center frequency |
| FSK | Space transmitter frequency |

**Table 2 Display frequency in each mode**

# CIRCUIT DESCRIPTION

In CW mode, the TS-940 receiving pitch can be changed to the required frequency while the desired signal remains in the center of the IF filter passband. (Variable CW pitch system)
The receiving pitch is interlocked and varies with the transmitter CW side tone. It is thus possible to immediately zero-beat by receiving the desired signal at the same pitch as the side tone. FSK transmission is executed in LSB mode. The audio signal made by dividing the reference frequency (space = $\frac{fSTD}{8720}$ ≒ 2.2936kHz, mark ≒ $\frac{1}{9400}$ = 2.1277kHz) is used as the AFSK (Audio Frequency Shift Keying) signal.

In FSK mode, unlike the operation in LSB mode, the IF is shifted (the dividing frequency N4 is shifted) for both transmission and reception so that the signal at 2.2936kHz/2.1277kHz passes through the center of the IF filter. The fVCO1 is shifted, since the display frequency is the space transmitter frequency. (The dividing ratio N1 is shifted.)
FM transmission is obtained in this system by modulating the fHET by applying the audio signal from the microphone to the VCO0.
The specifications of each frequency element are as follows.

| | | | |
|---|---|---|---|
| fSTD | 20MHz | | Standard : ±10PPM (-10°C~+50°C) max.<br>SO-1 mounted : ±0.5PPM (-10°C~+50°C) max. |
| fCP | 9MHz±ΔCP | | ΔCP = Carrier point adjustment component |
| fVB | 9MHz±ΔVB | | ΔVB = VBT initial setting adjustment component |
| | Dividing ratio | | |
| N0 | 1811 | | |
| N1 | 10000-10999 | | Applicable to the display frequency 0.00kHz-9.99kHz<br>+ 229 added in FSK mode. |
| N2 | 2310-2555 | | Applicable to display frequencies 000.00-490.00kHz and 500.00-990.00kHz.<br>(Only the integer multiple of 5 is used.) |
| N3 | 77-17 | | Applicable to every multiple of 500kHz within 30kHz-30MHz. |
| N4 | 9100 + (Mode shift)±Δ4 | | Δ4 = Variable band |
| | USB | −30 | AM-W, N 0 |
| | LSB | + 30 | FM 0 |
| | CW-W | −14 | FSK-W, N + 44 |
| | CW-N | 0 | |
| N5 | 14300±Δ5 | | Δ5 = Variable band |

## Local oscillator

### PLL Circuit

This is a digital VFO (Variable Frequency Oscillator) to cover a frequency range of from 45.08MHz-75.05MHz in 10Hz steps, in accordance with the TS-940s operating frequency of 30kHz-30MHz. Five PLL loops are linked in analog mode. The dividing ratio data to each PLL is controlled by the microprocessor.

Each loop is of a single crystal frequency control system : the VCO phase is compared with the unique reference frequency fSTD · CAR1 and CAR2 frequencies are inserted halfway in the analog link, enabling variable bandwidth functions such as VBT and slope tuning.
Operation of the PLL circuit is explained with reference to **Fig. 3** "PLL block diagram"

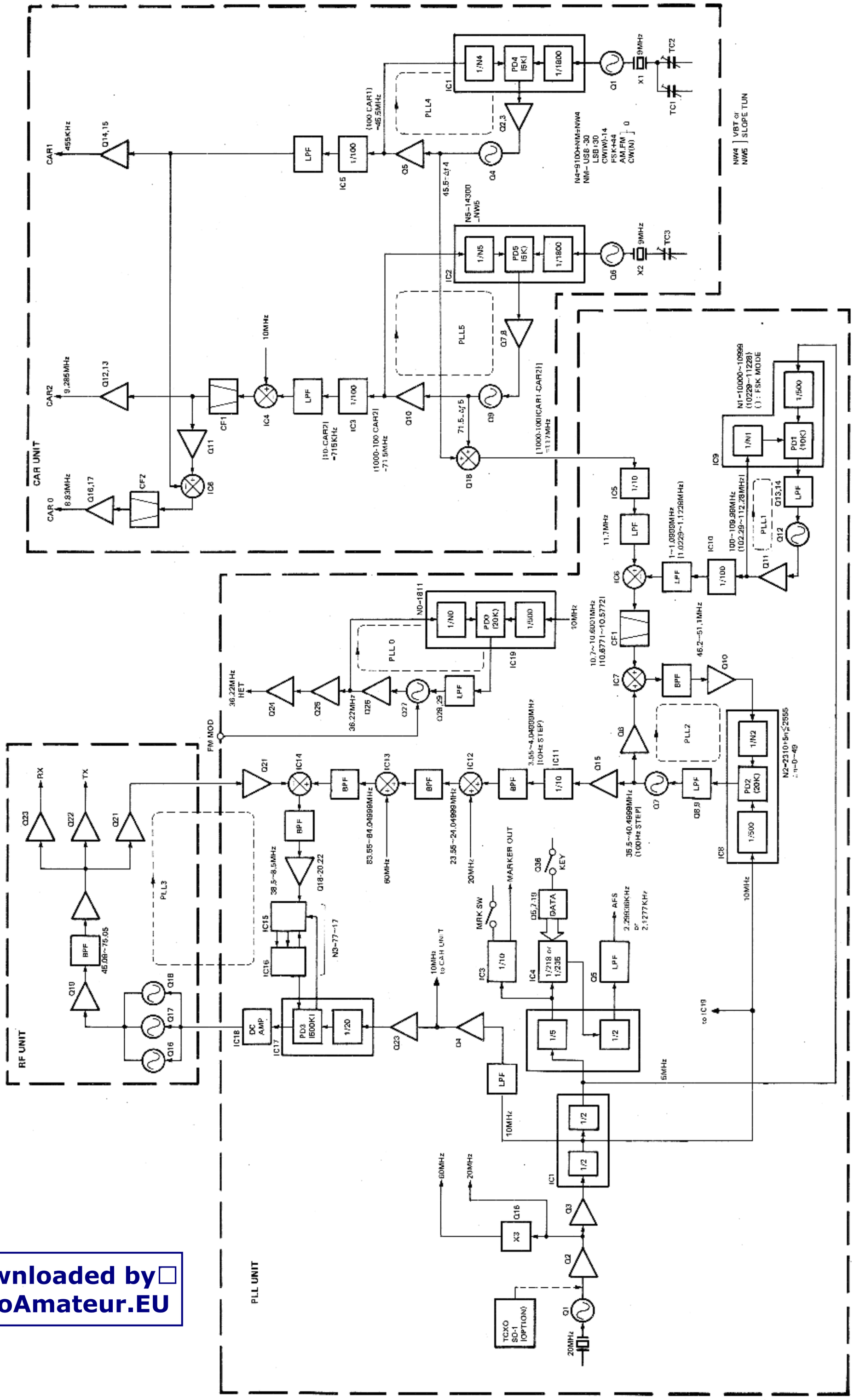


Fig. 3 PLL block diagram

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# CIRCUIT DESCRIPTION

The PLL-1 consists mainly of IC9 : MN6147. VCO1 of Q12 : 2SC2668 is locked in the 100-109.99MHz range. The 1/4 fSTD (5MHz) signal is supplied from the reference signal generator to IC9, where it is divided to 1/500 and output as a 10kHz comparison frequency.
The VCO1 output is applied to the same IC9 via buffer amplifier Q11, where it is divided to 1/N1. The signal is then coupled to the phase comparator, where it is compared with the above 10kHz signal, and the output locks PLL-1 in 10kHz steps.
As N1, the 1000 steps (10000-10999) of dividing data equivalent to the low order 9.99kHz width of the operating frequency is sent from the digital A unit to the PLL unit as a 4 bit serial data stream. A microprocessor is used for this data sending operation. (DA0-DA3, CK1) In FSK mode, as the space frequency is used as an operating frequency, N1 is shifted to 10229-11228.
The PLL-1 output is divided to 1/100 by IC10 : M54459L and becomes a signal of 1MHz-1.0999MHz (1.0229-1.1228MHz in FSK mode) in 100Hz steps. This signal sent from the PLL-1 channel to IC6 : SN16913P, i.e., the signal sent from the PLL-1 channel to IC6 is :

$$\frac{f_{VCO1}}{100}=\frac{1}{100}\times\frac{N1}{500}\times\frac{1}{4}\cdot f_{STD}=\frac{N1}{200000}\cdot f_{STD} \quad \cdots\cdots(1)$$

On the other hand, the fVCO4 + fVCO5 signal (approx. 117MHz) is sent from the carrier unit to PLL unit. This signal is divided to 1/10 by IC5 : HD10551 and applied to the mixer IC6. This signal is expressed by the equation :

$$\frac{1}{10}\cdot(f_{VCO4}+f_{VCO5})=\frac{1}{10}\left\{100\cdot f_{CAR1}+100\left(\frac{1}{2}f_{STD}-f_{CAR2}\right)\right\}$$

$$=5\cdot f_{STD}+10f_{CAR1}-10f_{CAR2} \quad \cdots\cdots(2)$$

It becomes a signal of approx. 11.7MHz. Therefore, IC6 output becomes a signal of approx. 10.65MHz expressed by :

$$5f_{STD}+10f_{CAR1}-10f_{CAR2}-\frac{N1}{200000}\cdot f_{STD} \quad \cdots\cdots(3)$$

Any mixer spurious is eliminated by ceramic filter CF1 : SFJ10.7MA-D and applied to the next PLL-2 loop. PLL-2 consists mainly of IC8 : MN6147, which locks the output signal of mixer IC7 : SN16913P, which is the VCO2 output of Q7 : 2SC2668 and the signal from CF1, in the range of 46.2-51.1MHz. The 1/2 fSTD (10MHz) signal is supplied from the reference frequency generator to IC8, where it is divided to 1/500 to make a comparison frequency of 20 kHz. The VCO2 output is applied to mixer IC7 via buffer amplifier Q6 : 2SC2668 and added to the signal (the configuration of equaion (3) ÷ 10.65MHz) from CF1, and this output is sent to IC8 via a BPF (Band Pass Filter) and amplifier Q10 : 2SC2668.

This signal is divided to 1/N2, compared in phase with the above 20kHz signal and used to control VCO2. This operaiton is expressed by :

$$\left(f_{VCO2}+5f_{STD}+10f_{CAR1}-10f_{CAR2}-\frac{N1}{200000}\cdot f_{STD}\right)$$

$$\times\frac{1}{N2}=\frac{1}{500}\times\frac{1}{2}f_{STD} \quad \cdots\cdots(4)$$

N2 means to cover the low order 500kHz width of the operating frequency in 10kHz steps and takes a numeric value of 50 steps which beocmes an integer multiple of 5 in the range 2310-2555. Like N1 in PLL-1, this data is sent by the microproceesor from the digital A unit to the PLL unit IC8 as a 4 bit serial data stream. (DA0-DA3, CK2) Therefore, the output signal of PLL-2 is expressed by the equation :

$$f_{VCO2}=\left(\frac{N1}{200000}+\frac{N2}{1000}-5\right)f_{STD}-10f_{CAR1}+10f_{CAR2} \quad \cdots\cdots(5)$$

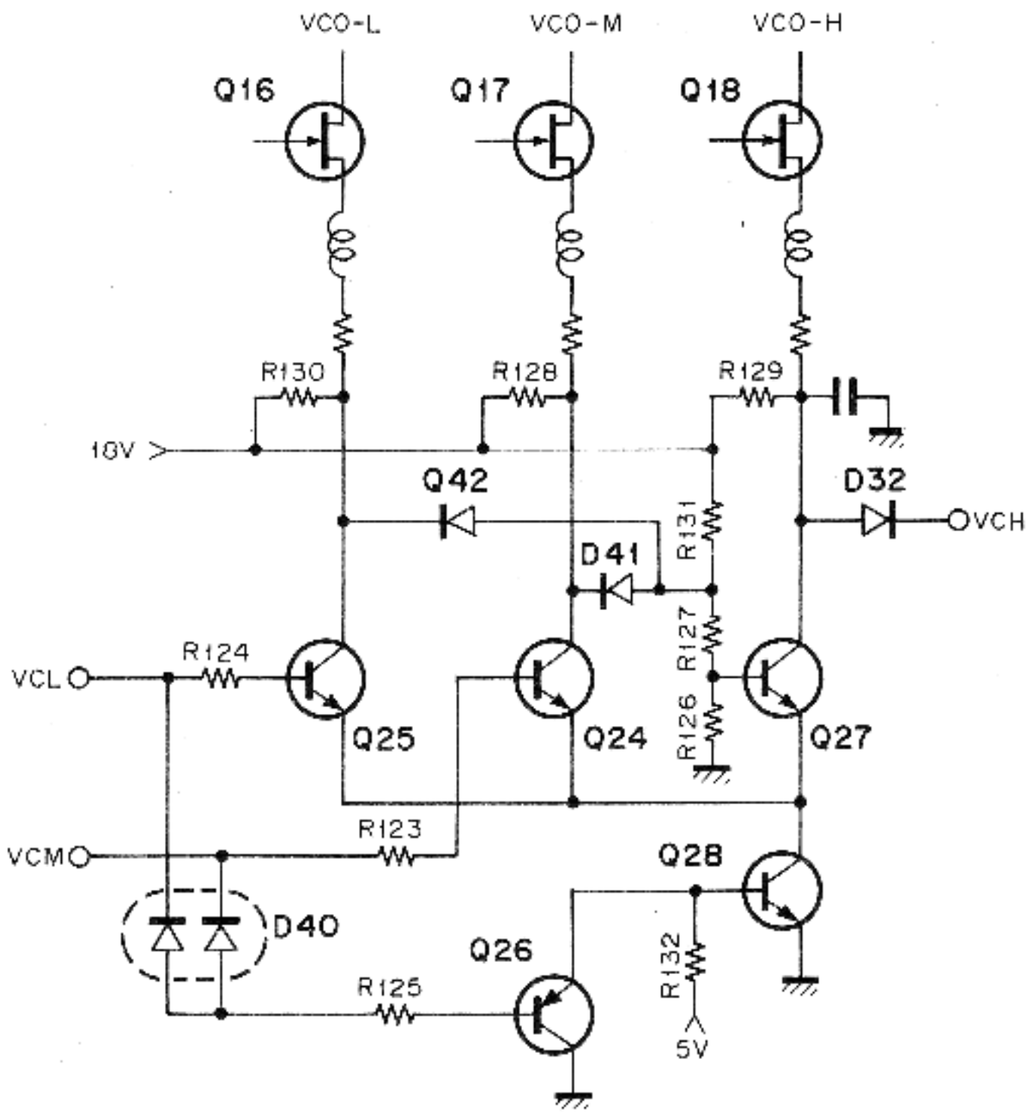
According to the values of N1 and N2, a frequency of 35.5-40.4999MHz is generated in 100Hz steps. The PLL-2 output is divided to 1/10 by IC11 : HD10551 via buffer amplifier Q15 : 2SC2668, and becomes a signal in 10Hz steps in the 3.55-4.04999MHz range.
First, fSTD (20MHz) is added in mixer IC12 : SN16913P and then, 3.fSTD (80MHz) is added in mixer IC13 : SN16913P and the signal is converted to 83.55-84.04999 MHz. As a result, 4.fSTD (80MHz) is added, but such a frequency configuration is employed in order to avoid unwanted mixer spurious components. This signal is applied to mixer IC14, where it is mixed with the final VCO output signal.

| Item | Rating |
|---|---|
| Center frequency | D : 10.64MHz±30kHz (Black) |
| 3dB band width | 280±50kHz within |
| 50dB bandwidth | 750kHz or less |
| Insertion loss $20\cdot\log\left(\frac{E1}{2E2}\right)$ | 7±2dB within |
| Spurious attenuation | 55dB or more at 9—13MHz |
| Input and output impedance | 330Ω |

**Table 3 PLL ceramic filter (L72-0349-04) (PLL unit CF1)**

# CIRCUIT DESCRIPTION

The final VCO is located on the RF unit and consists of three elements : Q16 : 2SK192A handling the frequency below 9.5MHz, Q17 : 2SK192A for 9.5-19.5MHz and Q18 : 2SK192A for 19.5MHz–30MHz. Each VCO is selected by the VCO select information (VCM or VCL, VCH is derived) sent from the Digital A unit by the microprocessor. The VCO selector circuit is shown in **Fig. 4**.
The oscillator output runs through the buffer amplifier Q19 : 2SC1907 and the high frequency component is eliminated by a BPF. The signal runs through the buffer amplifier Q20 : 2SC1907 and is then separated into three channels of buffered output.The Q21 : 2SC2668 output is supplied to the PLL unit, composing a final PLL loop. The Q22 : 2SC1907 output is applied to the third transmitter mixer. From Q23 : 2SC1907, the VCO output is applied to the first receiver mixer via amplifier Q6 : 2SC2053.




| Freq' (Hz) | VCO selected data VCM | VCL | Q25 | Q24 | Q27 | VCO freq' (MHz) | VCH |
|---|---|---|---|---|---|---|---|
| 30k–9.5M | L | H | O | X | X | 45.08–54.55 | H |
| 9.5M–19.5M | H | L | X | O | X | 54.55–64.55 | H |
| 19.5–30M | L | L | X | X | O | 64.55–75.05 | L |

O : ON X : CUT OFF

**Fig. 4 VCO selector circuit**

The signal from the RF unit final VCO is connected to the PLL unit VCO terminal and is applied to mixer IC14 via buffer amplifier Q21 : 2SC2668. Therefore, the mixer output becomes :

$$\frac{f_{VCO2}}{10}+f_{STD}+3f_{STD}-f_{VCO}=\left(\frac{N1}{2000000}+\frac{N2}{10000}+\frac{7}{2}\right)f_{STD}$$
$$-f_{CAR1}+f_{CAR2}-f_{VCO} \cdots\cdots\cdots (6)$$

This signal goes through a BPF and is amplified by Q18, 19 : 2SC2668, Q20 : 2SC1907 and Q22 : 2SC2668 and then, waveform shaped by IC15-1/3 : SN74S10N and applied to 1/3 or 1/4 prescaler IC16 : SN74S112N. IC16 is originally a dual function flip-flop circuit and works as a 1/4 divider, but its function is changed to a 1/3 divides by the control signal from the later stage PLL IC17 : MC145158, i.e., a pulse swallow divider is composed of IC17 internal divider, IC16 and IC15-1/3.
PLL IC17, the primary element of the final PLL loop PLL-3, is provided with the modulus control function which externally sets both the reference dividing ratio and comparison dividing ratio by serial data, and composes a pulse swallow counter using an external prescaler.
The 1/2 fSTD (10MHz) signal is supplied from the reference frequency generator to IC16 via buffer amplifier Q23 : 2SC2668. The signal is divided to 1/20 in IC16 to make a comparison output frequency of 500kHz.
The signal supplied from IC14 to the swallow counter via the BPF and amplifier is divided to 1/N3 and compared in phase with the 500kHz signal in the phase comparator. This controls the RF unit final VCO by the error correction voltage.
The operaiton is expressed by :

$$\left\{\left(\frac{N1}{2000000}+\frac{N2}{10000}+\frac{7}{2}\right)f_{STD}-f_{CAR1}+f_{CAR2}-f_{VCO}\right\}\times\frac{1}{N3}$$
$$=\frac{1}{20}\times\frac{1}{2}f_{STD} \cdots\cdots\cdots (7)$$

N3 means to cover the overall operating frequency range (30kHz-30MHz) in 500kHz steps and becomes 60 steps of 77-17. This data is also sent by the microprocessor from the Digital A unit to the PLL unit as serial data. (PLD, PLE and CK3)
As a result, the final VCO output signal is expressed by :

$$f_{VCO}=\left(\frac{160-N3}{40}+\frac{N2}{10000}+\frac{N1}{2000000}\right)\cdot f_{STD}-f_{CAR1}+f_{CAR2} \cdots\cdots (8)$$

According to the values of N1, N2 and N3, a frequency of 45.08-75.05MHz is generated in 10Hz steps. If fCAR1 is expressed by N4 and fCP and fCAR2 by N5, fVB and fSTD' respectively, equation (8) becomes the same as equation (8) provided in "Frequency Configuration".

# CIRCUIT DESCRIPTION

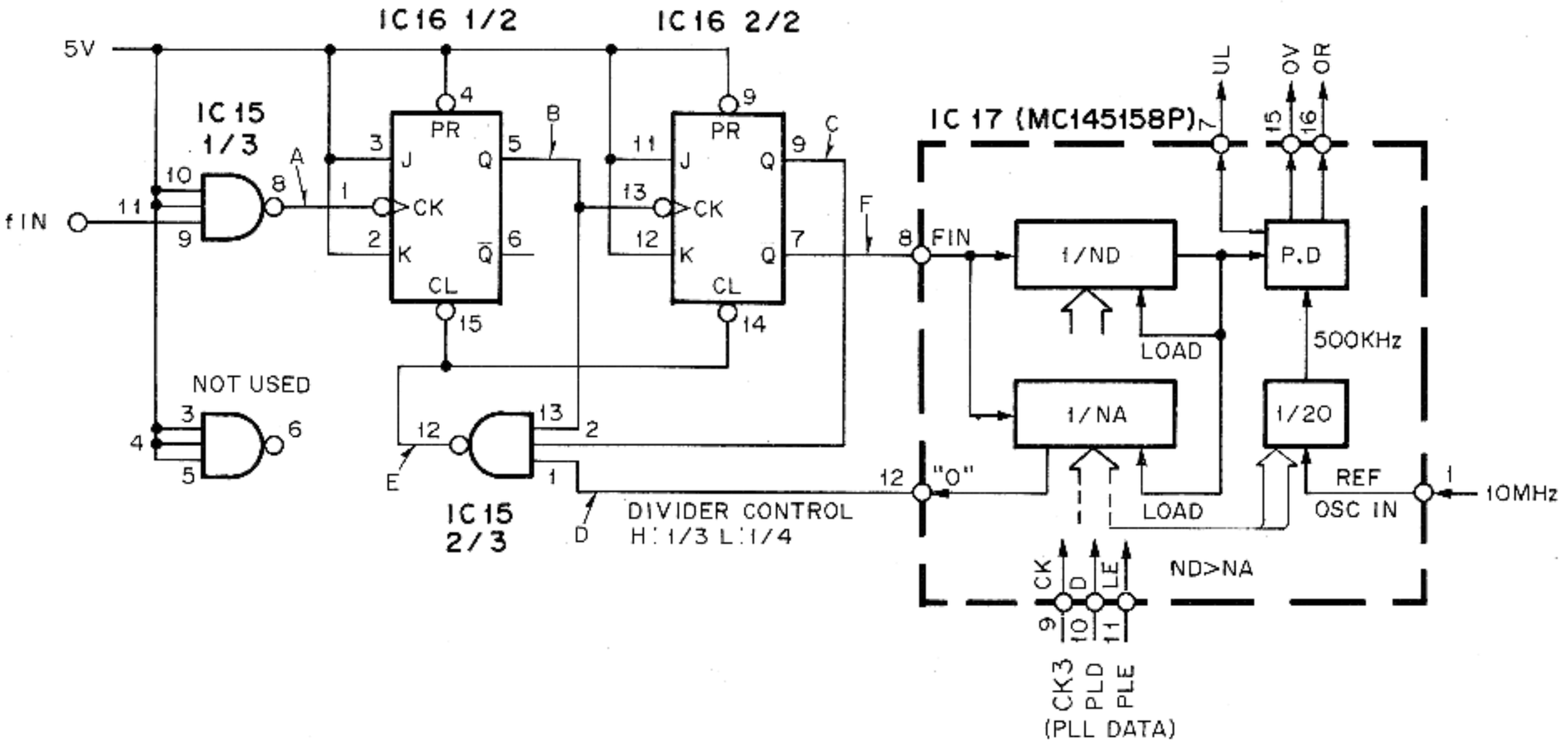



**Fig. 5-A Pulse swallow divider circuit**

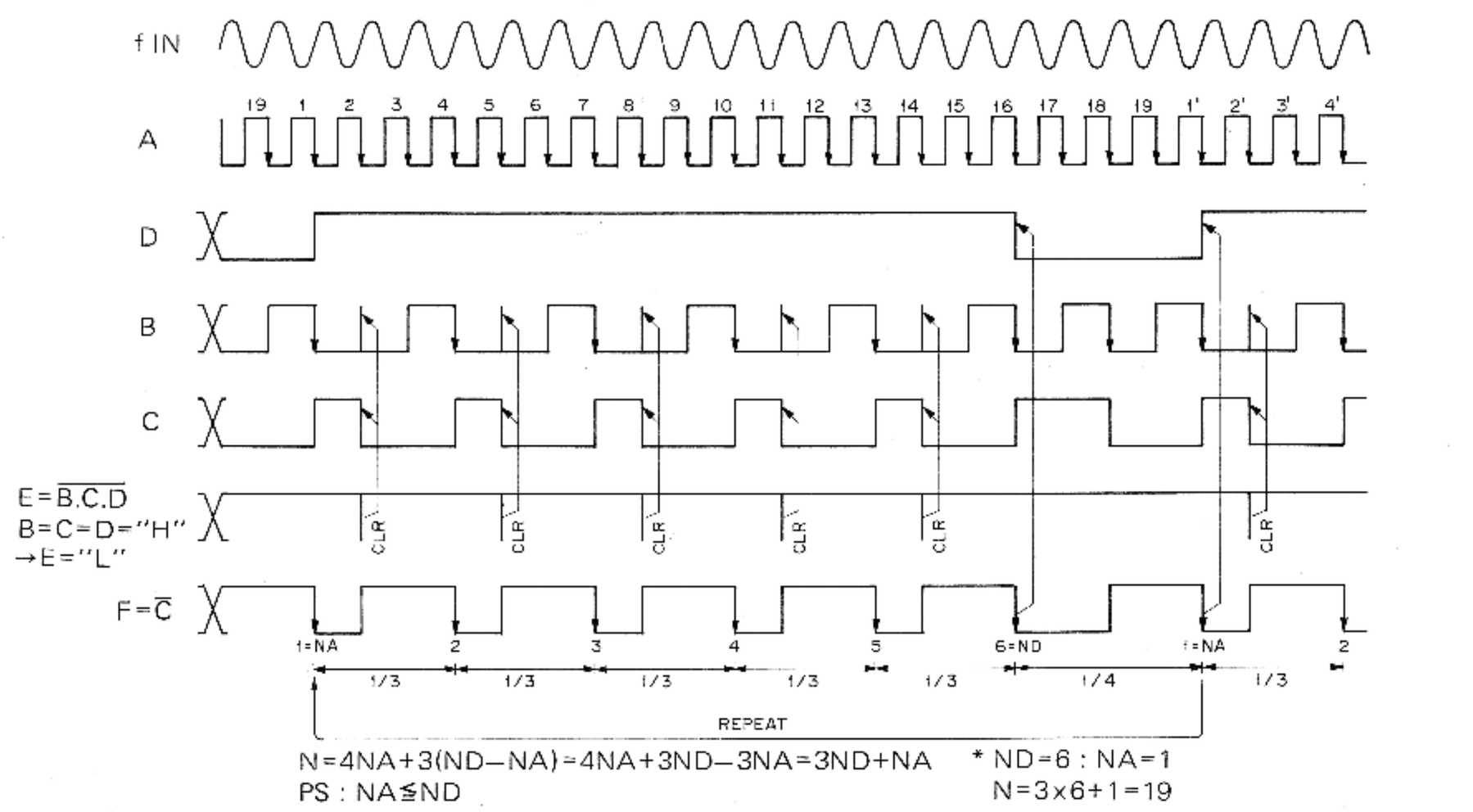



**Fig. 5-B Pulse swallow divider timing chart (At 29.0—29.5MHz band, ND=6, NA=1)**

- **HET (Heterodyne Oscillator)**

The HET oscillator is provided in the PLL unit, which is a PLL circuit (PLL-0) to generate a constant frequency signal of 36.22MHz. This output signal is connected to the IF unit and supplies the second transmitter/receiver mixer. In FM transmission mode, the audio signal from the micorphone is applied to this PLL to yield FM modulation.

PLL-0 consists mainly of IC19. VCO 0 is Q29 : 2SK129A, locked to 36.22MHz. A signal of 1/2 fSTD (10MHz) is supplied from the reference frequency generator to IC19, where it is divided to 1/500 to make a 20kHz comparison output frequency.

The oscillator output of VCO 0 is applied to IC19 via buffer amplifier Q26 : 2SC2668 and divided to 1/N0 (1/1811 constant) and the output is phase compared with the 20kHz reference signal in the phase comparator. This is used to lock the frequency of VCO 0. N0 (1811) is sent from the Digital A unit to the PLL unit. (DA0-DA3, CK0) The PLL-0 output is sent to the IF unit via buffer amplifiers Q25 : 2SC2668 and Q24 : 2SC1907 and an LPF (Low Pass Filter).

# CIRCUIT DESCRIPTION

### • CAR1

The CAR1 generator is provided in the digital B (CAR) unit, which makes a signal of approx. 45.5MHz on the basis of the 9MHz crystal oscillator and divides it to 1/100 in the PLL-4 circuit to generate a 455kHz signal. This signal is sent to the IF unit and mixed with the CAR3 signal to becomes a 355kHz signal. This is sent to the fourth receiver mixer in reception mode. In transmission mode, the signal is sent to the balanced modulator to generate a 455kHz DSB (Double Side Band) signal.

PLL-4 consists mainly of IC1 : MN6147. VCO4 (Q4 : 2SC2668) is locked to approx. 45.5MHz. A 9MHz signal is supplied from the $f_{CP}$ oscillator Q1 : 2SC2787 to IC1 and divided to 1/1800 to make a 5kHz comparison output frequency. VCO4 output is applied to IC1 via buffer amplifier Q5 : 2SC2668 and divided to 1/N4, and the output is phase compared with the 5kHz signal and is then used to lock VCO4 in 5kHz steps. The output signal from PLL4 is divided to 1/100 by IC5 : M54459L to become a signal of approx. 455kHz in 50Hz steps. This passes through the LPF and is supplied from output buffer Q14/Q15 : 2SC2458 to the IF unit as the CAR1 signal.

The non-divided 45.5MHz signal is applied to the mixer Q18 : 3SK73, where the PLL-5 output (the base of CAR2 signal) is added to the signal, and the output is sent to the PLL unit to form a part of the digital VFO.

Thus, the operating frequency is not changed even if the CAR1 frequency is changed, i.e., $f_{CP}$ and N4 are optional. When $f_{CAR1}$ is changed, IF shift is effected in both transmission and reception modes. This characteristic is used to realize USB/LSB mode switching functions, variable bandwidth, fine adjustment of carrier point, centering CW/FSK signals in the IF bandpass, etc. Fine adjustment of carrier point is provided by trimmer capacitors TC1 (for USB) and TC2 (for LSB) connected to the $f_{CP}$ crystal oscillator X1.

The other functions are executed by controlling N4 from the microprocessor. N4 is sent from the Digital A unit (a part of it is relayed by the PLL unit) as 4bit serial data. (A0-A3, CL4).

### • CAR2

The CAR2 circuit is provided in the digital B (CAR) unit, which generates a signal of approximately 71.5MHz on the basis of the 9MHz crystal oscillator. This is divides to 1/100 in the PLL-5 circuit to generate a 9.285MHz signal. This signal is sent to the IF unit and used as a local oscillation signal for the third receiver mixer in reception mode, and that of the first transmitter mixer in transmission mode. PLL-5 consists mainly of IC2 : MN6147.

A 9MHz signal is supplied from the $f_{VB}$ oscillator Q6 : 2SC2787 to IC1 and divided to 1/1800 to make a 5kHz comparison output frequency. The output of VCO5, Q9 : 2SC2668 is applied to IC2 via buffer amplifier Q10 : 2SC2668 and divided to 1/N5, and the output is compared in phase with the 5kHz signal and used to lock VCO5 to approx. 71.5MHz in 5kHz steps. The PLL-5 output signal is divided to 1/100 by IC3 : M54459L to become a signal of approx. 715kHz in 50Hz steps. It passes through a LPF and goes to IC4 : SN16913P, where it is mixed with 1/2 fSTD (10MHz) from the reference frequency generator to become the CAR2 signal at 9.285MHz. Any mixer spurious components within this signal are eliminated in ceramic filter CF1. The filtered signal is applied to the IF unit via buffer amplifier Q12/Q13 : 2SC2458. The 71.5MHz output signal from PLL-5 is applied to mixer Q18, where the PLL-4 output signal (the basis of the CAR4 signal) is added to the signal, and the output is sent to the PLL unit to form a part of digital VFO. Thus, like CAR1, the operating frequency is not changed even if the CAR2 frequency is changed, i.e., $f_{VB}$ and N5 are optional.

However, if the $f_{CAR2}$ is changed, IF shift is effected across the 8.83MHz filter (the second receiver IF filter) in both transmission and reception. (When the $f_{CAR2}$ is changed, the 455kHz filter is not shifted.) This characteristic is used to realize the variable bandwidth function.

Initialization of the VBT (Variable Bandwidth Tuning) adjustment (making the band center frequencies of the 8.83MHz and 455kHz filters the same) is performed by trimmer capacitor TC3 connected to the $f_{VB}$ crystal oscillator X2. The actual variable bandwidth function is realized by controlling N5 by the microprocessor. N5 is sent from the Digital A unit as A0-A3, and CL5 data.

| Mode | N4 Normal | SLOPE TONE or CW VBT : MAX | CAR/FREQ' (kHz) |
|---|---|---|---|
| USB | 9070 | → 9039 | 453.50 → 451.95 |
| LSB | 9130 | → 9161 | 456.50 → 458.05 |
| CW-W | 9086 | → 9071 | 454.30 → 453.55 |
| CW-N | 9100 | → 9093 | 455.00 → 454.65 |
| AM-W | 9100 | → 9069 | 455.00 → 453.45 |
| AM-N | 9100 | → 9085 | 455.00 → 454.25 |
| FM | 9100 | — | 455.00 → — |
| FSK-W | 9144 | → 9175 | 457.20 → 458.75 |
| FSK-N | 9144 | → 9151 | 457.20 → 457.55 |

**Table 4 N4 data shift**

| Mode | N5 Normal | SLOPE TONE or CW VBT : MAX | CAR/FREQ' (kHz) |
|---|---|---|---|
| USB | 14300 | → 14378 | 9285.00 → 9281.10 |
| LSB | 14300 | → 14222 | 9285.00 → 9288.90 |
| CW-W | 14300 | → 14362 | 9285.00 → 9281.90 |
| CW-N | 14300 | → 14315 | 9285.00 → 9284.25 |
| AM-W | 14300 | → 14362 | 9285.00 → 9281.90 |
| AM-N | 14300 | → 14330 | 9285.00 → 8293.50 |
| FM | 14300 | — | 9285.00 → — |
| FSK-W | 14300 | → 14238 | 9285.00 → 9288.10 |
| FSK-N | 14300 | → 14285 | 9285.00 → 9285.75 |

**Table 5 N5 data shift**

# CIRCUIT DESCRIPTION

### • CAR0

CAR0 is a signal of approx. 8.83MHz, which is derived by subtracting CAR1 from CAR2 in mixer IC6 provided on the CAR unit. Any mixer spurious components generated by IC6 : SN16913P are eliminated by ceramic filter CF2. The signal is then applied to both the IF and Control units via Q16 : 2SC2787 and Q17 : 2SC2458.

The signal applied to the IF unit is used as a transmission carrier in the CW and FM modes. The signal applied to the Control unit is used as the demodulation carrier for the monitor circuit in the SSB and FSK modes.

| Item | Rating |
|---|---|
| Nominal center frequency | 9.285MHz |
| 3dB Attenuation bandwidth | ±50kHz or more at 9.285MHz |
| Guaranteed attenuation | 45dB or more at 8.83MHz (−455kHz)<br>45dB or more at 9.74MHz (+ 455kHz)<br>40dB or more at 10.715MHz (+1430kHz) |
| Insertion loss $20 \cdot \log (\frac{E1}{2.2E})$ | 6dB or less |
| Ripple (within 3dB band) | 1.0dB or less |
| Input and output impedance | 330Ω |
| Voltage capacity | DC50V (1 minutes) |

**Table 6 CAR ceramic filter (L72-0350-05) (CAR unit CF1, IF unit CF3)**

| Item | Rating |
|---|---|
| Nominal center frequency | 8.830MHz |
| 3dB bandwidth attenuation | ±50kHz or more at 8.830MHz |
| Guaranteed attenuation | 35dB or more at 9.285MHz (+ 455kHz)<br>45dB or more at 9.74MHz (+ 910kHz) |
| Insertion loss $20 \cdot \log (\frac{E1}{2.2E})$ | 6dB or less |
| Ripple (3dB bandwidth) | 1.0dB or less |
| Input and output impedance | 330Ω |

**Table 7 CAR ceramic filter (L72-0351-05) (CAR unit CF2)**

### • CAR3

CAR3 on the IF unit generates three different frequencies depending on the mode (100kHz = CW, AM and FM, 98.5kHz = USB and 101.5kHz = LSB and FSK.) These are used as the BFO (Beat Frequency Oscillator) in the SSB and FSK modes, as a side tone generating carrier in the CW mode, and as a local oscillators signal for the fourth receiver mixer after being mixed with the CAR1 signal.

In CAR3, the tuning capacitors for each mode are selected by diode switches D69 and D70. Q33 : 3SK92A is the oscillator. The output is supplied from the CAR3 terminal to the side tone generator on the Control unit via buffer amplifier Q32 : 2SC2458, and at the same time, it is mixed with the CAR1 signal from CAR unit in mixer Q34 : 3SK73 to generate a local oscillator signal (fCAR1 − fCAR3) to be applied to the fourth receiver mixer. The output of Q32 is further applied to the SSB and FSK product detectors via buffer amplifiers Q31 and Q14 : 2SC2458.

### • CAR4

CAR4 on the IF unit serves as a BFO dedicated to CW demodulation, and as a side tone generating carrier. The oscillator frequency is 99.2kHz, but it is varied by the CW PITCH control so the receiving pitch can be set to the desired frequency in the CW mode. The CAR4 signal is generated by Q16 : 2SK192A and is applied to buffer amplifier Q15 : 2SC2458. The output is supplied from the CAR4 terminal to the Control unit generator side tone and, at the same time, it is applied to buffer amplifier Q14 via diode switches D34 and D68 and connects to the CW detector.

### • Reference frequency generator

The reference frequency fSTD' the frequency control base of the TS-940, is generated by the 20MHz crystal oscillator X1 and Q1 : 2SC2668 on the PLL unit, and further applied to buffer amplifier Q2 : 2SC2787. X1 and Q1 are replaceable by the optional TCXO (Temperature Compensated Crystal Oscillator) SO-1.

The output of Q2 is used as the 20MHz fSTD as is. It is also multiplied three times to provide 60MHz 3fSTD. Further, it is divided to 1/2 by half of IC1 : SN74LS73AN to provide 10MHz 1/2 fSTD. This 1/2 fSTD is supplied to the CAR unit via buffer amplifier Q4 : 2SC2787 as well as being used in the PLL unit. The 1/2 fSTD is further divided to 1/2 by the other half of IC1 to provided a 5MHz 1/4 fSTD.

### • AFSK signal and marker signal

A part of the 5MHz (1/4 fSTD) signal generated by the PLL unit frequency generator reference is applied to 1/5 divider IC2 : SN74LS90N to provide a 1MHz (1/20 fSTD) signal. This signal is applied to programmable divider IC4 : MC14569BCP. The dividing ratio of this IC is switched between 218/235 interlocked with the FSK key SPACE/MARK setting. The output of IC4 returns to IC2, passes through the 1/2 divider, establishes a 50% duty cycle and is then sent to the microphone amplifier circuit of the IF unit via active LPF Q5 : 2SA1115, where it is converted to an FSK modulation signal.The total dividing ratio is 1/8720 fSTD (2.2936kHz) in SPACE and 1/9400 fSTD (2.1277 kHz) MARK. The shift width is 165.9Hz, which is a slight deviation from the standard value, but no problem in practical use.

The carrier frequency and shift width during transmission are the same in accuracy as fSTD' and are very stable. In modes other than FSK, IC4 stops operation and thus, an AFSK signal is not output.

The marker signal chain divides the 1MHz (1/20 fSTD) signal from the preceding stage IC2 to 1/10 through IC3 : SN74LS90N to generate 100kHz signals (1/200 fSTD). When the marker switch is off, IC3 is reset and the operation is stopped.

# CIRCUIT DESCRIPTION

## Receiver

The signal received through the antenna is applied to the RF unit (X44-1660-00) ANT terminal. The signal passes through the transmitter/receiver selector circuit and goes out from the EXT terminal. The output is connected to the RF unit RXA terminal via the selector circuit provided on the rear panel. This signal is applied to the receiver BPF through the RF attenuator (0, 10, 20, or 30dB selectable) via relays RL1 and RL2. The BPF divides the received frequency range (up to 30MHz) into nine bands, which are automatically selected by RX BPF control data (RB0–RB3) from the Digital A unit (X54-1830-00).

| Received freq' (MHz) | RX BPF select data | | | | RX BPF |
|---|---|---|---|---|---|
| | RB0 | RB1 | RB2 | RB3 | |
| – 0.5 | 0 | 0 | 0 | 0 | A |
| 0.5– 1.5 | 1 | 0 | 0 | 0 | B |
| 1.5– 3 | 0 | 1 | 0 | 0 | C |
| 3 – 4 | 1 | 1 | 0 | 0 | D |
| 4 – 7 | 0 | 0 | 1 | 0 | E |
| 7 – 8.5 | 1 | 0 | 1 | 0 | F |
| 8.5–14 | 0 | 1 | 1 | 0 | G |
| 14 –20 | 0 | 0 | 0 | 1 | H |
| 20 –30 | 1 | 1 | 1 | 0 | I |

**Table 8 Selection of RX BPF**

The signal from the BPF runs through the RF AGC circuit composed of PIN diodes D23 and D26 : MI204. It is then amplified by RF amplifier comprising Q10 : 2SK125 pair and applied to the first receiver mixer Q9 : 2SK125 pair, where it is mixed with the VCO signal, and the output is converted to the first IF signal at 45.05MHz. This signal is applied to the grounded gate post amplifier Q7, 8 : 2SK125, and the output is applied from the RIF terminal to IF unit (X48-1430-00).

The unwanted signal components are eliminated from the 45.05MHz first IF signal when it passes through the MCF XF1 with 15kHz bandwidth. The signal is then applied to the second receiver mixer Q4 and Q5 : 2SK125, mixed with the HET signal (36.22MHz) and converted to the second IF signal (8.83MHz). This signal is separated into two channels : one is supplied to the noise blanker on the Control unit (X53-1420-11), and the other is applied to the second IF signal filter circuit via the noise blanking gate comprised of diodes D3—D6 : 1S1587.

This filter circuit is provided with crystal filter XF2 : YK-88S1 with a 2.7kHz bandwidth for SSB (used also for wide CW/FSK and narrow AM), and wide band LC filters L37, L38 for FM (used also for wide AM when the optional AM filter is not provided.) As an option, the filter circuit permits use of two kinds of filters : a YK-88C-1 with 500Hz bandwidth for CW and a YK-88A-1 with 6kHz bandwidth for AM. These four filters types are automatically selected by the W/N-mode information (WN, ND2 and MD1) from the Digital A unit via the keyboard.

| MODE | W/N SWITCH | WN | MD2 | MD1 | 2nd IF | 3rd IF |
|---|---|---|---|---|---|---|
| SSB | W | 0 | 0 | 0 | 2.7kHz | 2.7kHz |
| | N | 1 | 0 | 0 | 2.7kHz | 2.7kHz |
| CW, FSK | W | 0 | 0 | 1 | 2.7kHz | 2.7kHz |
| | N | 1 | 0 | 1 | 2.7kHz (Option : 500Hz) | 2.7kHz (Option : 500Hz or 250Hz) |
| AM | W | 0 | 1 | 1 | Wide band (Option : 6kHz) | 6kHz |
| | N | 1 | 1 | 1 | 2.7kHz | 2.7kHz |
| FM | W | 0 | 1 | 0 | Wide band | * 6kHz |
| | N | 1 | 1 | 0 | Wide band | * 6kHz |

* : 12kHz B.W IF Filter used in FM mode.

**Table 9 Selection of filters**

The received signal, having passes through the second IF filter, is applied to the third receiver mixer Q7,8 : 3SK73 to be mixed with the CAR2 signal (9.285MHz) and then converted to the third IF signal (455kHz). The output is then separated into two channels. One is connected to the Control unit FIN terminal, goes through IF amplifier Q45 : 2SC2787 and third IF filter CF1 : CFV455F. It is then applied to limiter amplifiers IC11 and IC12 : $\mu$PC577H for amplitude limiting, and the output is applied to ceramic discriminators L12 : CFY455S for FM detection. The detected output is supplied from the FMV terminal to the IF unit for the FM mode signal via the de-emphasis circuit and, at the same time, the noise component near 40kHz is eliminated. The signal is then connected to the squelch circuit, noise amplifier Q46 and Q47 : 2SC2458, noise rectifier D80 and D81 : 1SS33 and the comparator consisting of IC13 2/2 : NJM4558S.

The above Control unit circuits function not only in the FM mode, but in all modes. Therefore, one noise squelch system is employed in all modes. The squelch control output mutes the IF unit audio amplifier via the MTU terminal. (IF unit Q28)

The third IF signal is amplified by Q10 : 3SK73 on the IF unit and is then applied to the filter circuit as the third IF signal.

This filter circuit is provided with ceramic filter CF1 : CFJ455K12 with a 2.7kHz bandwidth for SSB (used also for wide CW/FSK and narrow AM) and ceramic filter CF2 : CFW455HT with a 6kHz bandwidth for AM wide. As an option, the filter circuit provides for use of either a CW 500Hz crystal filter : YG-455C-1 or 250Hz : YG-455CN-1 bandwidth filter. These three filter types are automatically selected by information from the Digital A unit, like the second IF filters. For selection operaton data, refer to Table. 1. The signal from the third IF filter is amplified by Q11 : 3SK73 and applied to the fourth receiver mixer to be mixed with the 355kHz (CAR1—CAR3) signal and converted to the fourth IF signal. The output is applied to Q13 : 3SK73 via the notch filter circuit. This amplifier output is detected by either the SSB/CW product detector or the AM detector. The detected signal is applied to AF GAIN control via the squalch gate Q28 : 2SC2458 and preamplifier Q29 : 2SC2459. In CW mode, it is also possible to pass the signal through the AF TUNE circuit, IC1 and IC2 :

# CIRCUIT DESCRIPTION

BA718. The output of Q3 is also applied to the AGC circuit. The received AF signal from the AF GAIN control is applied to the Control unit, where it is amplified by the audio power amplifier IC15 : HA1368 and used to drive the speaker.

| Item | Rating |
|---|---|
| Nominal center frequency (fo) | 45.050kHz |
| Passband width | ±7.5kHz or more at 6dB |
| Attenuation bandwidth | 30dB or more at fo±25kHz<br>60dB or more at fo±150kHz<br>Spurious level : 20dB or more |
| Guaranteed attenuation | 60dB or more within<br>fo±150kHz–fo±1000kHz |
| Ripple | 1.5dB or less |
| Insertion loss | 4dB or less |

**Table 10 MCF (L71-0254-05) (IF unit XF1)**

| Item | Rating |
|---|---|
| Nominal center frequency | 8830kHz |
| Center frequency deviation | ±150Hz within at 6dB |
| Passband width | ±1.35kHz or more at 6dB |
| Attenuation bandwidth | ±1.7kHz or less at 20dB<br>±2.5kHz or less at 60dB<br>±3.4kHz or less at 80dB |
| Ripple | 2dB or less |
| Insertion loss | 6dB or less |
| Guaranteed attenuation | 80dB or more within<br>±3.4kHz–±1MHz |
| Input and output impedance | 600Ω//15pF |

**Table 11 MCF (L71-0222-05) (IF unit XF2)**

| Item | Rating |
|---|---|
| Nominal center frequency | 455kHz |
| 6dB bandwidth | ±3kHz or more |
| 50dB bandwidth | ±9kHz or less |
| Ripple (within 455 ± 2kHz) | 2dB or less |
| Loss | 6dB or less |
| Guaranteed attenuation (within 455kHz ± 100kHz) | 60dB or more |
| Input and output impedance | 2.0kΩ |

**Table 12 AM ceramic filter (L72-0319-05) (IF unit CF2)**

| Item | Rating |
|---|---|
| Center frequency | 455 ± 0.20kHz |
| 6dB bandwidth | 2.9–3.2kHz |
| 60dB bandwidth | 4.7kHz or less |
| Guaranteed attenuation (0.1–1MHz) | 60dB or more |
| Spurious (600–700kHz) | 40dB or more |
| Ripple | 2dB or less |
| Loss | 6dB or less |
| Input and output impedance | 2kΩ |

**Table 13 SSB ceramic filter (L72-0333-05) (IF unit CF1)**

| Item | Rating |
|---|---|
| Nominal center frequency | 8830.0kHz |
| Center frequency deviation | Within ±70Hz at 6dB (25°C) |
| Pass bandwidth | ±250Hz or more at 6dB |
| Attenuation bandwidth | ±900Hz or less at 60dB |
| Guaranteed attenuation | 80dB or more within<br>±2kHz–±1MHz |
| Ripple | 2dB or less |
| Loss | Within 5dB ± 2dB |
| Input and output impedance | 600Ω / 15pF |

**Table 14 CW crystal filter YK-88C-1 (L71-0236-05) Option**

| Item | Rating |
|---|---|
| Nominal center frequency | 8830.0kHz |
| Center frequency deviation | Within ±250Hz at 6dB |
| Pass bandwidth | ±3.0kHz or more at 6dB |
| Attenuation bandwidth | ±6kHz or less at 60dB<br>±10kHz or less at 80dB |
| Ripple | 2dB or less |
| Loss | Within 3dB ± 2dB |
| Guaranteed attenuation | 80dB or more within<br>±10kHz–±1MHz |
| Input and output impedance | 600Ω / 15pF |

**Table 15 AM crystal filter YK-88A-1 (L71-0237-05) Option**

| Item | Rating |
|---|---|
| Center frequency | 455kHz |
| Center frequency deviation | Within 50Hz at 6dB |
| Pass bandwidth | ±250Hz or more at 6dB |
| Attenuation bandwidth | ±425Hz or less at 60dB |
| Ripple | 2dB or less |
| Loss | 6dB or less |
| Guaranteed attenuation | 80dB or more within<br>100Hz–454.4kHz<br>80dB or more within<br>455.6kHz–2MHz |
| Input and output impedance | 2kΩ ± 5% / 15pF ± 5% |

**Table 16 CW crystal filter YG-455C-1 (L72-0238-05) Option**

| Item | Rating |
|---|---|
| Center frequency | 455kHz |
| Center frequency deviation | Within 50Hz at 6dB |
| Pass bandwidth | ±125Hz or more at 6dB |
| Attenuation bandwidth | ±250Hz or less at 60dB |
| Ripple | 2dB or less |
| Loss | 6dB or less |
| Guaranteed attenuation | 80dB or more within<br>100Hz– 454.6kHz<br>80dB or more within<br>455.4kHz–2MHz |
| Input and output impedance | 2kΩ ± 5% / 15pF ± 5% |

**Table 17 CW crystal filter YG-455CN-1 (L72-0239-05) Option**

# CIRCUIT DESCRIPTION

## Additional circuit

- **Noise blanker (provided on the Control circuit)**

**Fig. 6** give a block diagram of the noise blanker. This circuit is comprised of two channels, NB1 and NB2. The signal taken from the tuned output circuit of the second receiver mixer, comprised of Q4 and Q5 on the IF unit, is supplied from the NA terminal to the Control unit and amplified approx. 70dB by Q12–Q15.

In the case of the NB1 channel, the noise signal is detected by diodes D64 and D65 through the buffer Q16 and then applied to the switching transistors Q18 and Q22. In the case of the NB2 channel, the noise is directly applied to the noise detector comprising D61 and D62. The NB1 channel takes out only the pulse noise contained in the input signal and switches the noise blanking gate composed of diodes D3–D6, located before the IF unit XF2.

NB1 channel operaion is conventional. On the other hand, the noise output dertected by D61 and D62 in the NB2 channels is waveform shaped by IC5 after running through D63 and Q19, and only the high level pulse component is taken out as a square wave.

This component is switched by Q38 and in turn is used to switch the NB gate via D66 and Q22. At the same time, it is also used for switching the third receiver mixer Q7, Q8 on the IF unit via Q20 and Q21. The NB2 channel is especially effective for that special noise known as " the woodpecker".

In addition, in the TS-940, the "click" noise generated when the frequency is changed one step by the digital VFO is eliminate through the NB2 channel by utilizing the BLK signal from the Digital unit. The functions of the NB circuit are described in detail below.

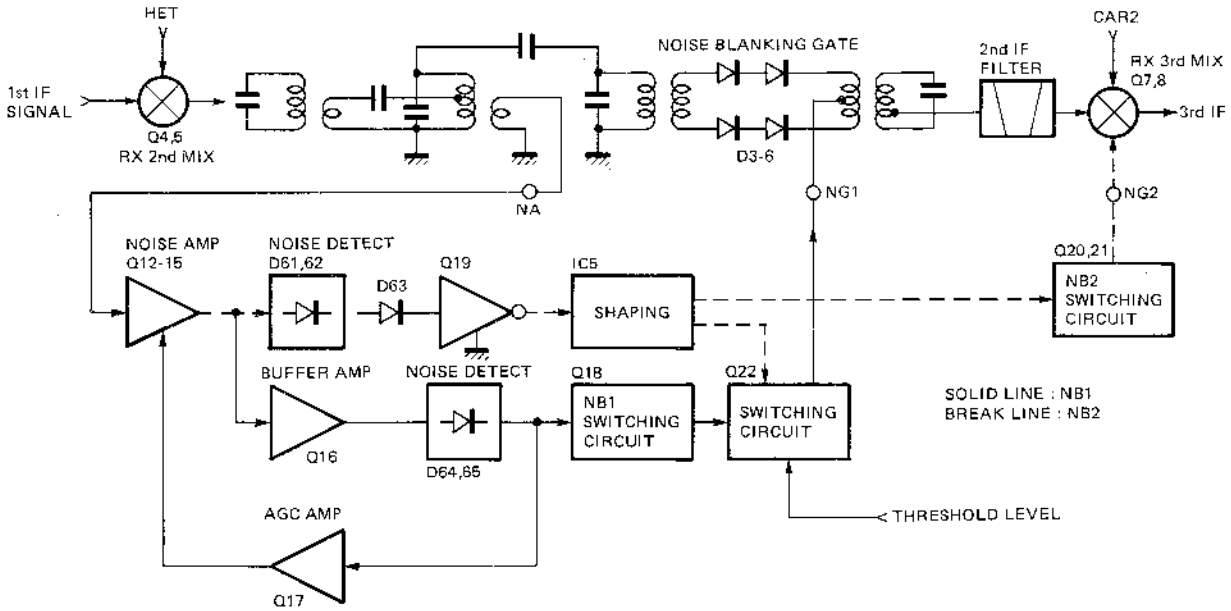



**Fig. 6 Noise blanker circuit**

In **Fig. 7**, Q18 and Q22 form a conventional NB circuit, which controls the NB gate. When the NB1 switch S14 is turned on, Q18 turns on and controls Q22 according to whether or not a pulse noise exists, and opens or closes the NB gate comprising D3 - D6 on the IF unit.

NB LEVEL (VR7) varies the operating threshold of Q18 so the NB effect can be varied.

Next, NB2 is explained. When a signal corresponding to a noise is applied to Q19, the collector of Q19 is set to a low level (hereafter abbreviated Lo. (and high level to Hi.) IC5, pins 11 and 9 are Hi, because pin 12 is Lo due to R172. As described above, when the collector (IC5, pin 8) of Q19 becomes Lo, IC5, pin 10 becomes Hi. As pin 10 next becomes Hi, a charging current flows in C76, pin 12 becomes Hi and pins 11 and 9 become Lo, in sequence.

As pin 9 becomes Lo, pin 10 is held Hi. This holding time is determined by the charge constant of C76 and R172, approx. 4ms. If this time is exceeded, pins 11 and 9 are returned to their initial states, Hi.

During this period, the conventional NB1 channel is operating through D66, and Q20 and Q21 are operating, whereby the third mixer (Q7 and Q8 on the IF unit) is cut off. Even if pins 11 and 9 become Hi, the base voltage of Q21 is in the state of cutting off the charging voltage determined by R175 and C78, and it continuously cuts off the third mixer. This is the control for NB2.

# CIRCUIT DESCRIPTION

IC5, pin 6 is connected by R171 (56kΩ) and returned to Hi when the NB2 control time (about 4ms) elapses. Upon this change from Lo to Hi, a charging current flows in C77 through R173 and changes pins 1 and 2 from Lo to Hi. IC5, pins 3 and 5 become Lo, keeping pin 4 Hi and holding the charging time determined by C77 and R173, approx. 80ms. During this period, IC5, pin 13 is held Lo (pin 11 is Hi) through D68 so the NB2 does not mis-fire with a normal pulse for approx. 80ms from the time the first noise pulse goes out, even if a pulse noise is again entered. This is the operation for periodic woodpecker noise. When the NB2 channel is on, conventional noise is also blanked because one pole of S15 operates the NB1 circuit.

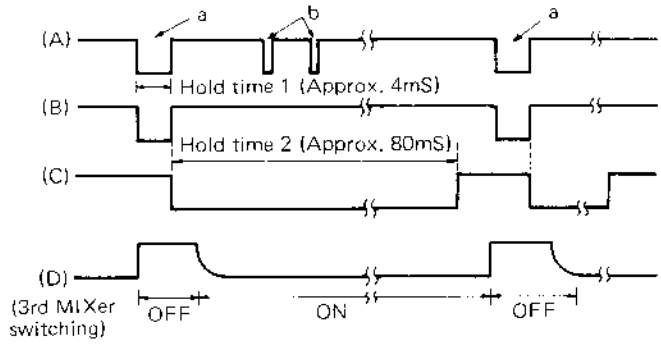



Fig. 8 NB2 timing chart

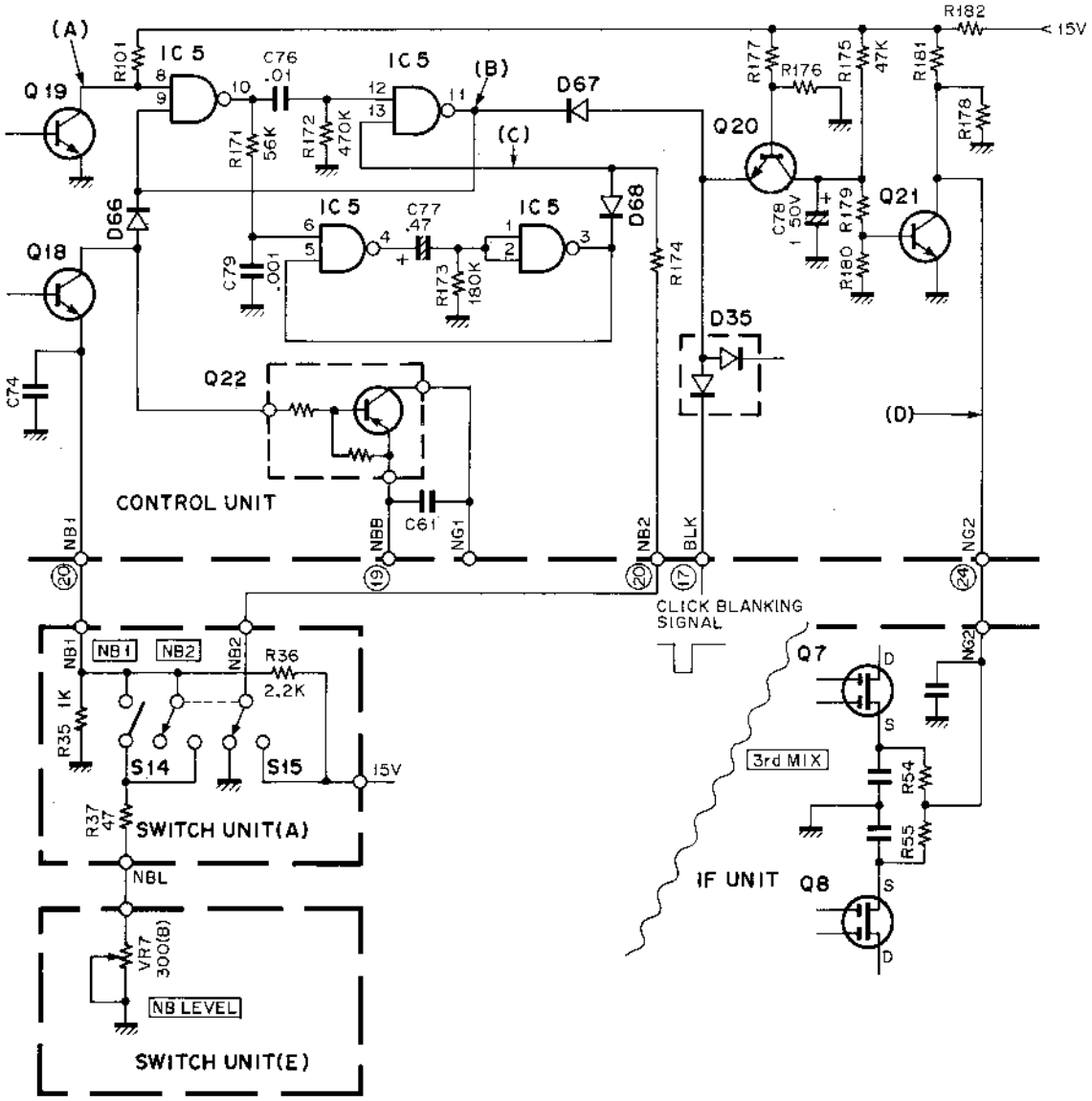



Fig. 7 NB gate control circuit

# CIRCUIT DESCRIPTION

- **CW-VBT, SSB-SLOPE-TUNE (RF/IF and PLL/CAR unit)**

**Fig. 9** gives a block diagram of the receiver related to CW-VBT (Variable Bandwidth Tuning) and SSB-SLOPE-TUNE. The principle of CW-VBT operation will be explained first. When CAR1 and CAR2 are at their normal frequencies, the overall IF response is indicated by "A". When the CAR1 frequency is shifted by Δf1, the overall IF response curve shifts to that at "B". The circuit is designed so the CAR1 signal lowers the VCO frequency fL by Δf1. In this case, the IF bandwidth is fully opened, or normal. When the frequency of CAR2 is lowered by Δf2, only the second IF filter of 8.8MHz band shifts to position "C". This maybe interpreted that IF shift is acheived by CAR1 and the composite bandwidth is narrowed by CAR2. In the TS-940, CAR1 and CAR2 frequencies are generated by the PLL circuit and controlled by the microprocessor, and the amount of change Δf1 and Δf2 is digitally tracked, allowing only the bandwidth to narrow without changing the center frequency of the composite passband. This is the function of CW-VBT.

Next, the operating principle of SSB-SLOPE-TUNE is explained, Designed so the relation between the frequency changes of CAR1 and CAR2 becomes Δf2 = Δf1,the composite passband can be varied only on the left in **Fig. 10**. If the CAR1 frequency is fixed and the CAR2 frequency is lowered by Δf2, it is possible to vary only the right of the composite passband.

The SSB-SLOPE-TUNE enables these operations independently, using two controls.

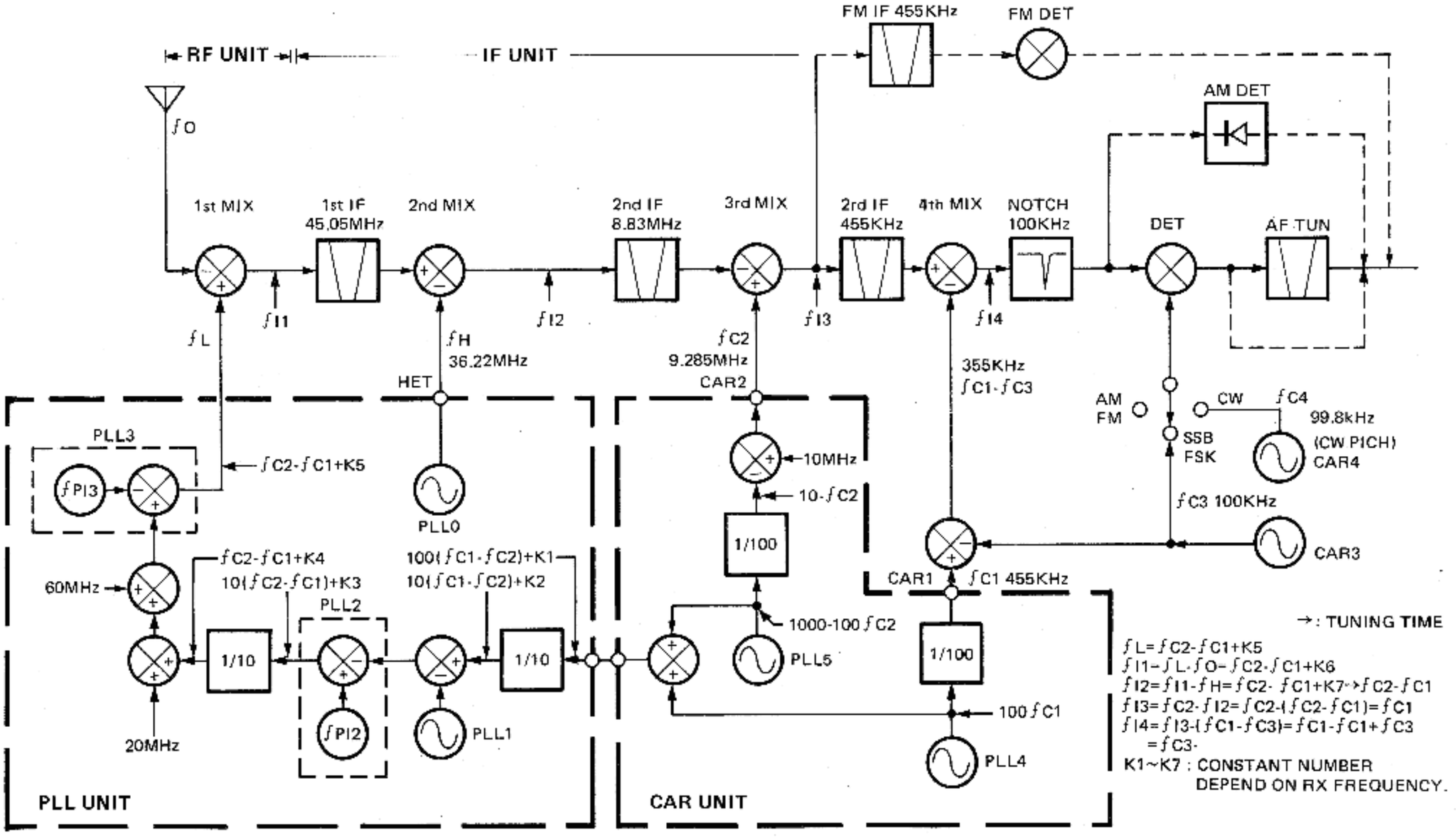



**Fig. 9-A RX configuration normal (wide) response**

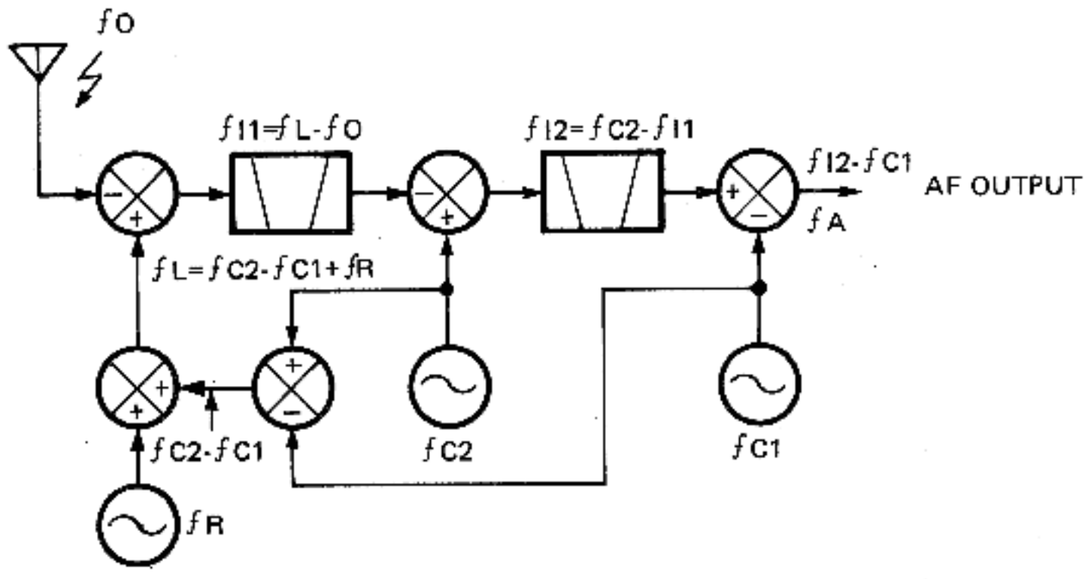



**Fig. 9-B**

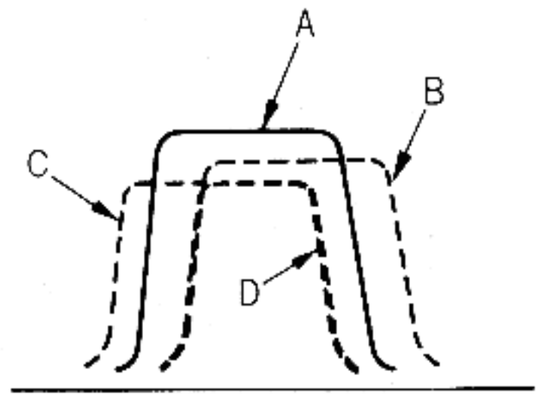



**Fig. 9-C CAR2 shifted**

# CIRCUIT DESCRIPTION

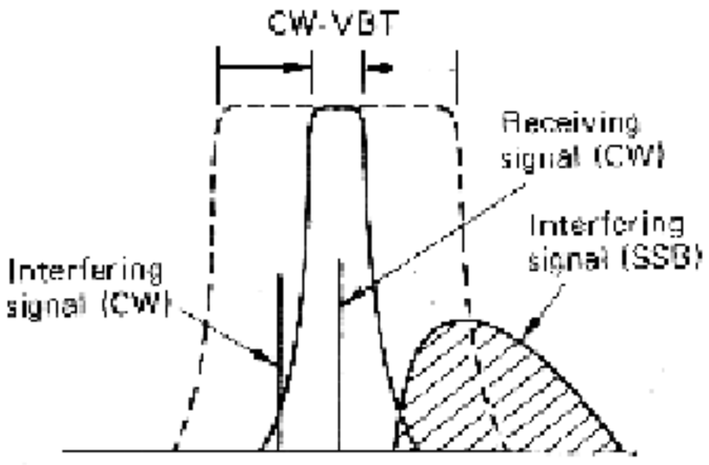



Fig. 9-D CW-VBT

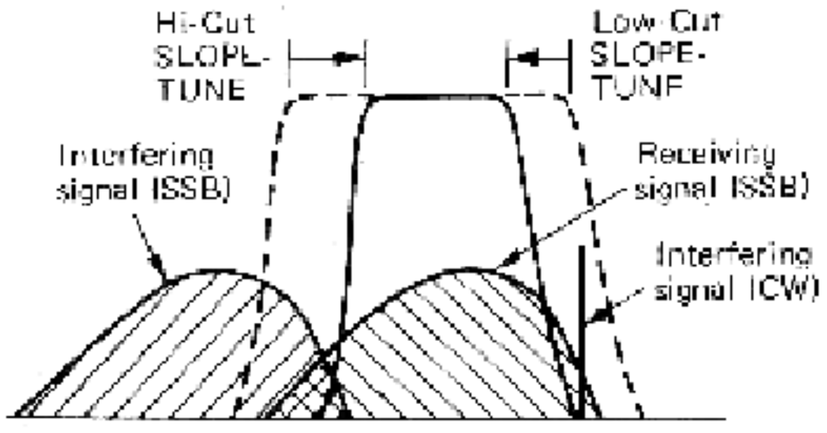



Fig. 9-E SSB-slope tune

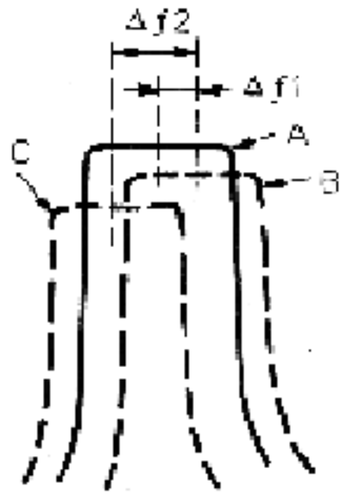



Fig. 10 VCO to bandwidth relationship

- **Notch filter (provided in the IF unit)**

This is a bridge T filter composed of L, C and R elements, which is inserted between the fourth receiver mixer and the 100kHz IF amplifier Q13. It varies the voltage applied to the cathode of varicap diode D38, thereby changing the resonant frequency. The notch filter functions in all modes except FM.

- **AF-TUNE (provided on the IF unit)**

This is an active filter using IC12, which is inserted between the SSB/CW product detector and AF pre-amplifier Q29. The frequency of this filter is over 800 (±400)Hz and functions only in the CW mode. When the AF-TUNE switch is off, the audio signal is bypassed by diode D68.

## Transmitter

The audio signal from the microphone is applied to the IF unit MIC terminal and is preamplified by Q36 : 2SC2458. The output is split to the MIC GAIN control (on the front panel), the FM MIC GAIN control (on the top panel) and VOX circuit in the SSB and AM modes. The SSB signal channel is returned to the IF unit, amplified by IC3 : TA7140P and applied to balanced modulator D73 : ND487R1-3R. A diode switch is provided at the input of IC3, which selects the audio signal in the SSB and AM mode, and the AFSK signal (2.2936kHz/2.1277kHz) from the PLL unit in the FSK mode. Balanced modulator D73 is constructed as a package containing four Schottky diodes of matched characteristics, which provides stable modulation characteristic against varying operating conditions such as temperature fluctuation. The 455kHz DSB (Double Side Band) signal from D73 is converted to SSB by filter CF1 (or CF2 in the AM mode), which is shared by the third receiver IF filter after passing through the buffer amplifier Q37 : 3SK73.

The filter output runs through buffer amplifier Q39 : 2SC2458 and is then applied to the RF speech processor circuit Q40: 2SC2458, IC4 : TA7302P and Q43 : 3SK73. When the processor is off, the signal is applied directly to the first transmitter mixer Q44 and Q45 : 3SK73 via diode switch D78 and D79 : 1S1587. In FSK mode, even if the processor switch is off, aprox. 10dB compression is automatically applied. This effectively suppresses any level difference between MARK and SPACE in AFSK. Note, however, that the compression meter does not deflect.

In the AM mode, even if the processor switch is off, the signal runs through D78 and D79 but does not pass through the processor. The processor output signal is applied to the first transmitter mixer via diode switch D83. Here, the audio signal is mixed with the CAR2 signal (9.28bMHz) and converted to 8.83MHz. The 8.83MHz signal runs through SSB filter XF2 (a wide band filter L37, L38 or optional YK-88A-1 in AM mode) shared by the second receiver IF filter, where any adatter component which may be generated in the speech processor is eliminated.

The signal is then applied to the transmitter IF amplifier Q48 : 3SK73. However, in CW and FM modes or during auto antenna tuning, the CAR0 signal is applied to Q48 via buffer amplifier Q46 : 3SK73. Therefore, in these modes, since the transmitter signal does not pass through the narrow band filter, full CW break-in operation is enabled. ALC is applied to transmitter IF amplifier Q48, and a part of its output is supplied from the MON terminal to the monitor circuit on the Control unit via buffer amplifier Q49 : 2SC2787.

The transmitter signal is then applied to the second transmitter mixer Q50 and Q51 : 3SK73, where it is mixed with the HET signal (36.22MHz), yielding a TIF signal at 45.05 MHz, whose output is connected to the RF unit. In the RF unit, the signal is mixed with the VCO signal in the third transmitter mixer Q1 and Q2 : 3SK73, providing the final transmitter frequency.

# CIRCUIT DESCRIPTION

Any unwanted components in this signal are eliminated in the transmitter BPF (1.8–30MHz), amplified by wideband amplifier Q3 : 3SK73, Q4 : 2SC1907 and Q5 : 2SC1973 and supplied from the DRV terminal to the Final unit as the drive-level output. This drive output is automatically disconnected from the Final unit input if a connection is plugged into the transverter connector. The signal applied to the Final unit is amplified by wideband drivers Q2, Q3 : MRF485 and finals Q4, Q5 : MRF422.
The output of the Final unit passes through the Filter unit where unwanted the higher harmonic component element is eliminated. The Filter unit divides the transmitter frequency range into bands, and each LPF is automatically selected by TX LPF information (LP0–LP2) supplied from the Digital A unit.
After passing through the Filter unit, the transmitter output runs through the AT (optional) unit, the transmitter/receiver selector circuit and then is connected to the ANT terminal on the rear panel.

| Transmit freq' (MHz) | TX-LPF selected data | | | LPF |
|---|---|---|---|---|
| | LP2 | LP1 | LP0 | |
| 1.9 | 0 | 0 | 1 | A |
| 3.5 | 0 | 1 | 1 | B |
| 7 | 1 | 1 | 1 | C |
| 10 | 1 | 0 | 1 | D |
| 14 | 1 | 1 | 0 | E |
| 18 | 1 | 0 | 0 | F |
| 21 | 1 | 0 | 0 | F |
| 24.5 | 0 | 1 | 0 | G |
| 28 | 0 | 1 | 0 | G |

**Table 18 Selection of TX LPF**

- **Final temperature protection circuit (provided on the Filter unit)**

If the Final heat sink temperature rises to approx. 90°C, temperature protection comparator IC1B on the Filter unit switches from low to high level, and Q8 turns off. Therefore, approx. 12V, the total voltage of zener diode D11, variable resistor D12 (1.7V) and zener diode D13, is generated at the MOT terminal, the motor speed is increased and the final heat sink is cooled more rapidly.
At the same time, the high level signal from IC1B is sent to the Control unit via the BTP terminal to stop transmission and forably sets the receive mode.
When the sink temperature falls to approx. 65–70°C, this circuit is released and transmit mode is again enabled. thereafter, the fan is driven by the cooling fan driving circuit until the heat sink temperature further lowers to approx. 45°C.

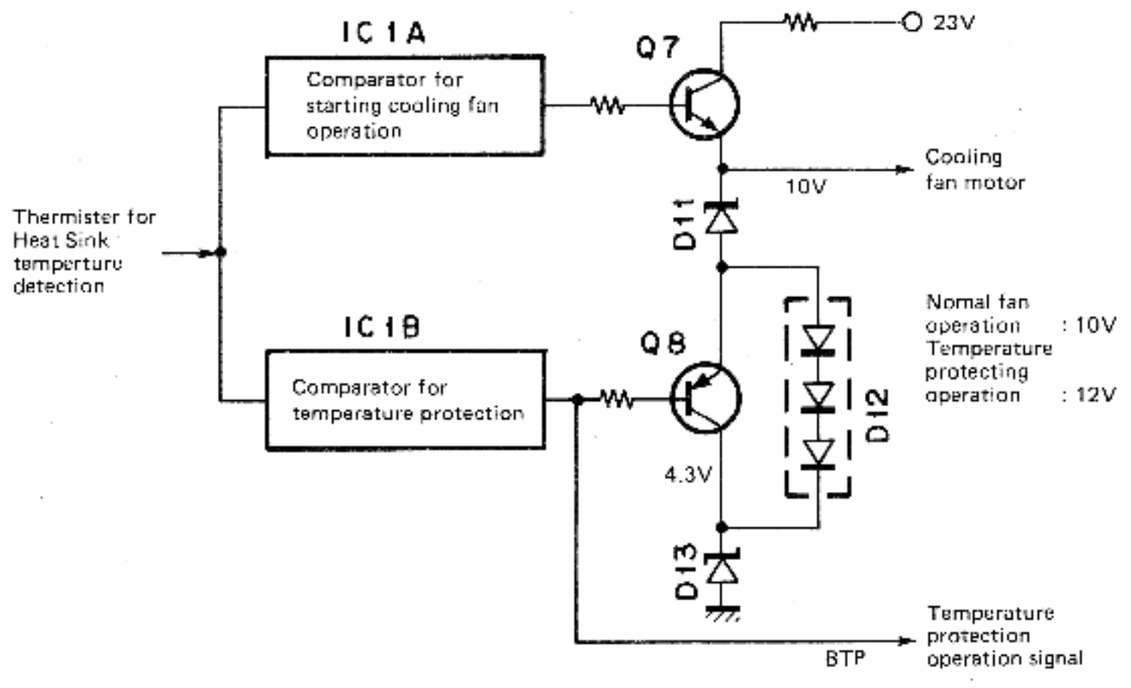



**Fig. 11 Fan and temperature protection**

## Additional transmitter circuits

- **Final cooling fan driving circuit (provided on the Filter unit)**

First, the final heat sink temperature is detected by thermistor TH1 provided on the Final unit. If the heat sink temperature rises to approx. 50°C. comparator IC1A functions (high level) to start cooling fan operation and Q7 turns on. At this time, the temperature protection comparator IC1B is low level, and Q8 is on. Therefore, approx. 10V (D11 : Zener voltage 5.1V, D13 : Zener voltage 4.3V, Q8 : VCF SAT 0.1–0.3V) appears at the MOT terminal and drives the fan motor.
This circuit is designed with hysteresis so the fan stops when the Final heat sink temperature falls to approx. 45°C.

- **ALC circuit (provided on the Control unit)**

Forward wave voltage VSF detected in the Filter unit is applied to the base of Q36 in the Control unit. Q36 and Q37 are differential amplifiers. When the VSF voltage rises, the collector voltage of Q37 rises and that of Q35 lowers. Therefore, the gate voltage of Q33 lowers and the base and emitter voltages of Q34 lower. As a result, the ALC line volatege decreases due to D46 and Q34 being connected to the ALC line, thus controlling TX RF output power.

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# CIRCUIT DESCRIPTION

The drain (voltege) of Q33 operates the ALC meter. Trim controls VR8, VR9 are the internal set points for the ALC meter circuit. The TBK line voltage delivers the keying signal through active low-pass filter Q32 where any key click components are eliminated, its output becomes ALC voltage, and this is supplied to the ALC line. As seen from this description, the ALC voltage is used not only for controlling transmitter output power, but is also for keying the output in the CW operating mode.

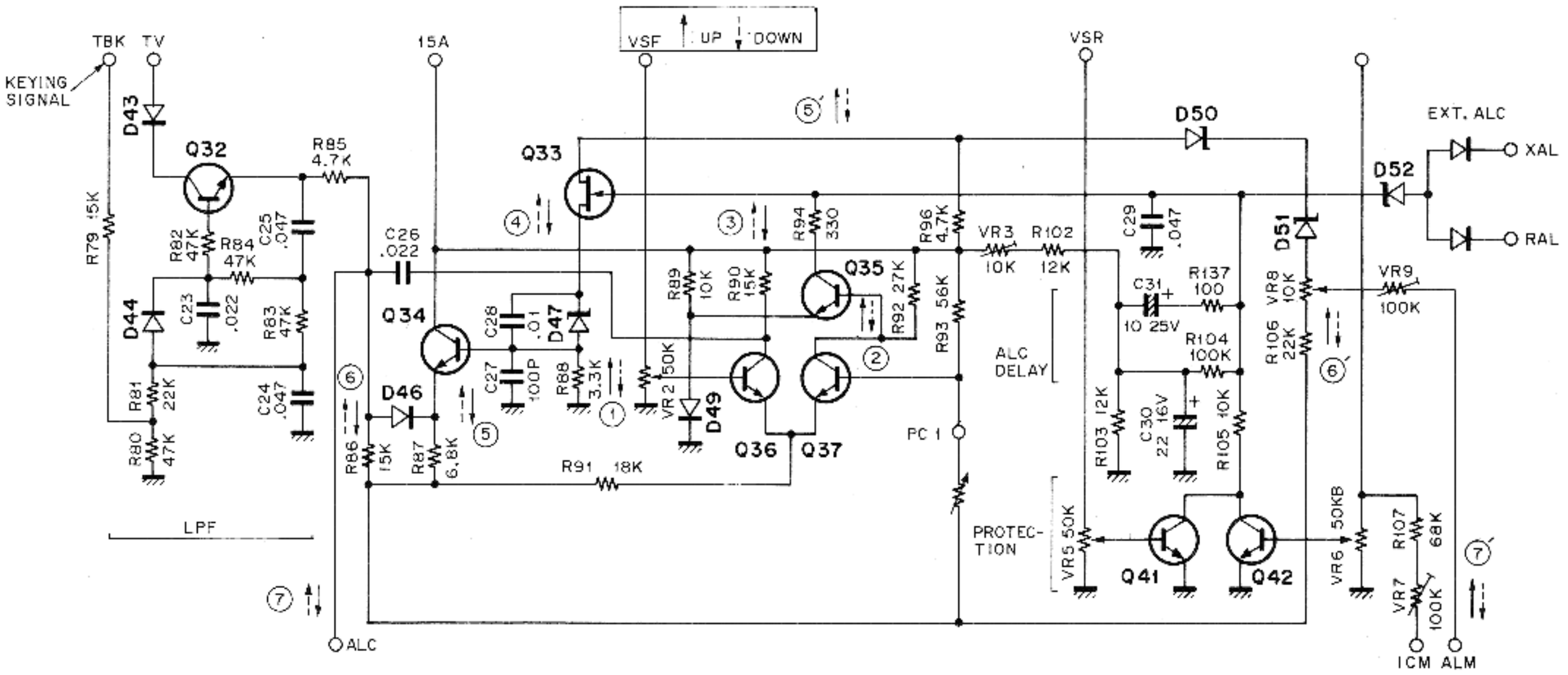


**Fig. 12 ALC circuit**

- **Power control**

The power control provided on the front panel permits control of transmitter output from full power to 10W or less. The power control is a 2-ganged potentiometer, which controls the first gate voltage of broad band amplifier Q3 in the RF unit to vary the voltage gain. Secondly, it controls the base voltage of ALC circuit differential amplifier Q37 in the Control unit and therefore the threshold level of the ALC amplifier. Therefore, when the Power control is varied, ALC is held nearly constant at any setting.

If the auto antenna tuner were to be used with the transmitter output set to minimum (10W or less) by the Power control, the RF output power might be too low to detect the necessary controlling current and voltage and normal tune operation would not be possible.

To solve this problem, the TS-940 is designed to automatically switch FET Q3 gate voltage the RF unit voltage amplifier to its maximum value, regardless of the power control, set position, and at the same time, switch the base voltage of Q37 to provide a 50W RF output level to properly operate the auto tuner.

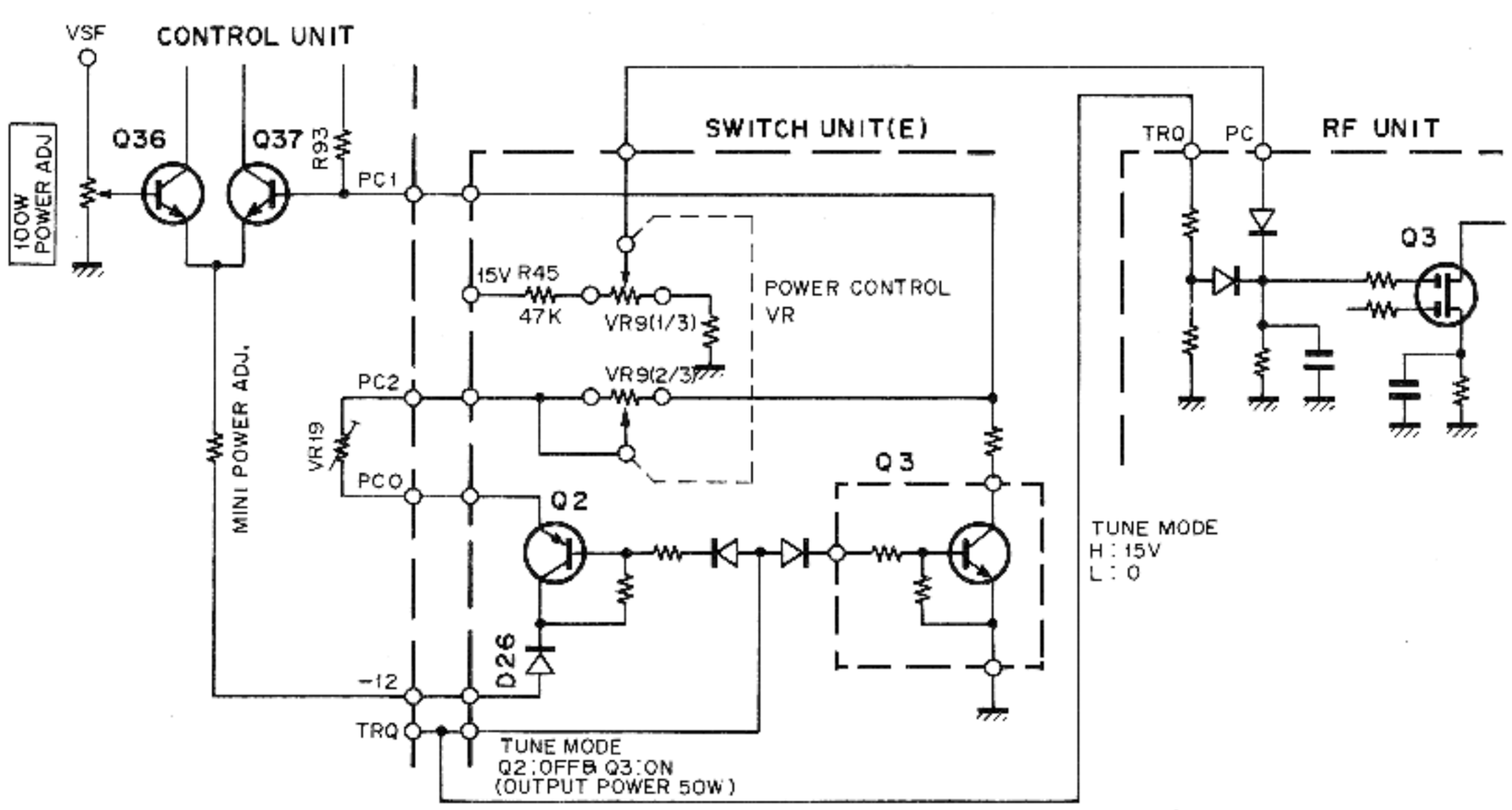


**Fig. 13 Power control circuit**

# CIRCUIT DESCRIPTION

- **Speech processor (provided on the IF unit)**

The block diagram is shown in **Fig.14**. An input signal runs through 455kHz filter CF1 and buffer Q39. The signal is then amplified by Q40 and applied to detector D80 and limiter amplifier IC4. The detector output is applied to DC amplifier Q41 and Q42, where it is compressed logarithmicly. The output signal is coupled to the compression meter, indicating the compression level. The signal applied to IC4 is held constant in output level regardless of the input level. The signal is then applied to the first transmitter mixer via gain controil amplifier Q43.

When the processor is off, the signal is bypassed by switching diodes D78 and D79. In FSK mode, even if the processor is off, approximately load compression is applied to level the amplitude change between the mark and space signals. In the FSK mode, the ALC level is adjusted by the processor OUT control

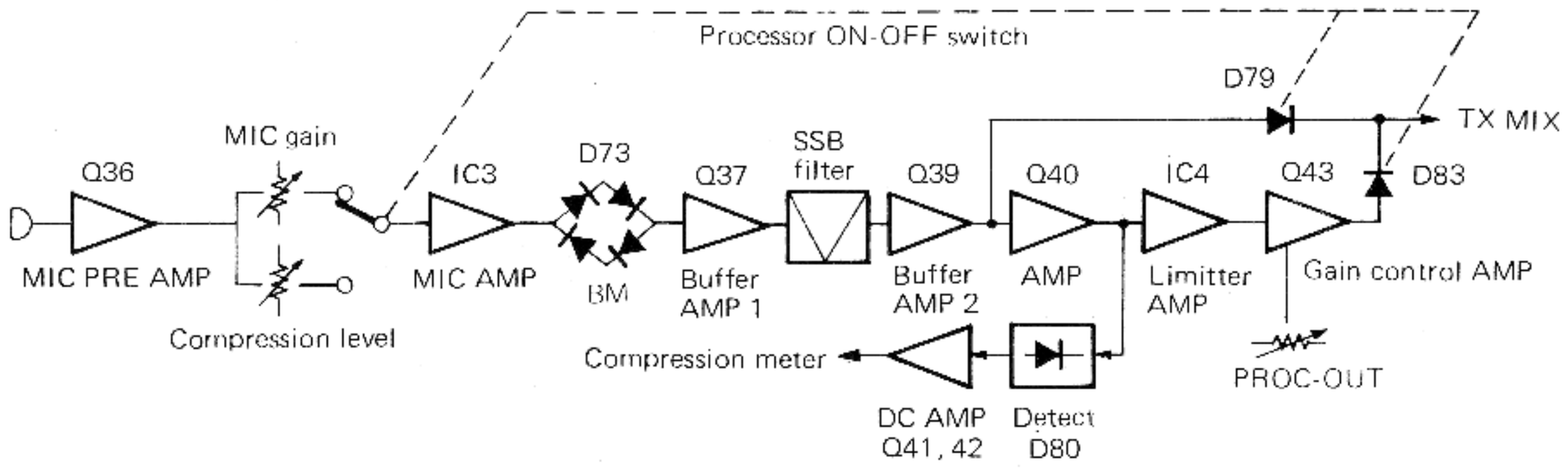


**Fig. 14 Speech processor block diagram**

- **Monitor circuit (provided on the Control unit)**

SSB/FSK mode

The signal taken from the drain of the second transmitter IF amplifier Q48 on the IF unit is amplified by Q49 and applied to the MON terminal. The output signal from the MON terminal is applied to IC16 : μPC1037H via the Control unit buffer Q58.

In IC16, the CAR0 (8.83MHz) is injected for signal product detection. This is amplified by Q59 and applied to the audio power amplifier IC15 via the monitor level internal adjustment control VR13.

FM mode

The output of the FM microphone amplifier Q64, Q65 and IC14 is amplified by Q62 and supplied to VR13, as in the SSB/FSK mode.

CW mode

Side tone circuit (provided on the Control unit)

CAR3 and CAR4 signals of 100kHz and 99.2kHz are product detected by Q57 to generate an audio beat at 800Hz. Q57 is switched by the STK line through diode D71 and turned on when the key is closed, generating side tone. The 99.2kHz CAR4 signal is frequency controlled by the pitch control on the front panel, allowing simultaneous variation of the CW side tone frequency and receiver CW tone pitch. Zero-beat adjustment with a received signal is acheived by simply making the receiving tone pitch equal to the side tone pitch.

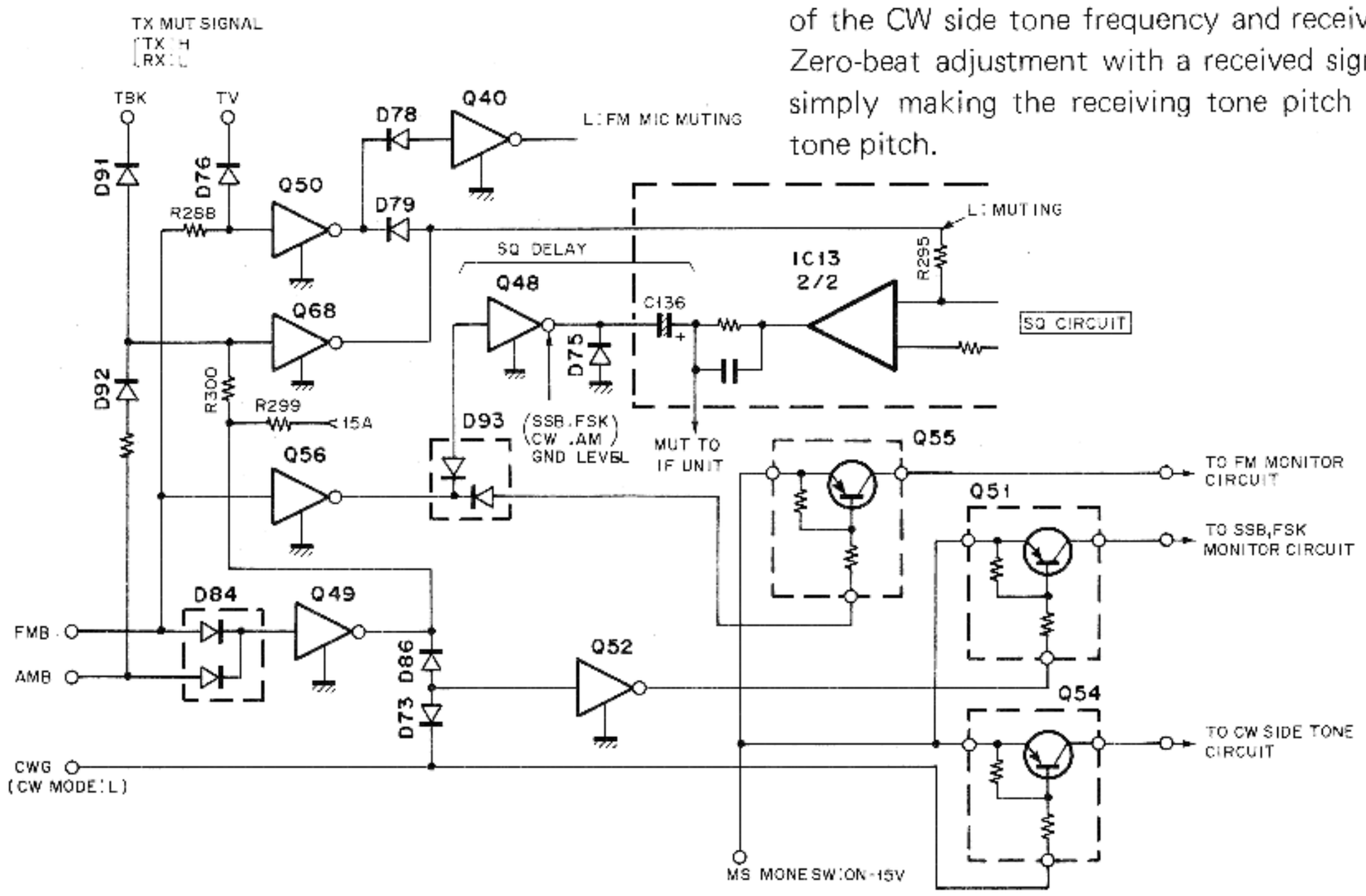


**Fig. 15 Monitor, audio muting and FM mic muting circuit**

# CIRCUIT DESCRIPTION

- **SWR automatic arithmetic circuit (provided on the Control unit)**

The automatic SWR arithmetic computation circuit has been adopted from the original circuit first used in the TS-930. The forward wave voltage VSF and reflected wave voltage VSR from the Filter unit are applied to an analog arithmetic circuit on the Control unit, output from IC9, pin 1 as VSR/VSF level, and indicated by the SWR meter. IC9 contains an integrating circuit and V–I converter for the auto tuner, while IC10 contains a triangular wave generator and voltage comparator. Q43 and Q44 are used for switching the forward and reflected wave input signals at an equal duty ratio.

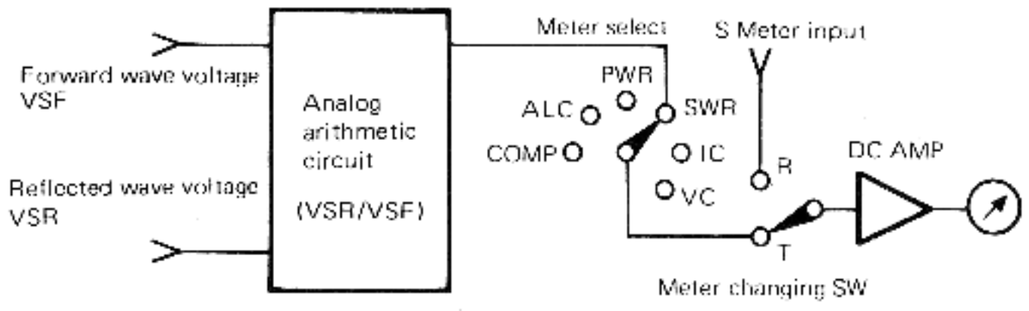


**Fig. 16 SWR meter circuit**

The VSF voltage is compared with a REF voltage on IC9 pin 12. If VSF decreases (i.e. SWR increases) the voltage level at pin 14 increases. The output of IC10 pin 1 is a triangular reference signal and is mixed with the voltage from IC9 pin 14. Changes in the outuput of IC9 pin 14 affect the reference level of this triangular wave. IC10 computes the change and sends a square wave signal, whose pulse width and spacing are proportional to the change, to control conduction of switching transistors Q43, Q44. See **Fig. 17.**

The voltage at IC9 pin 1 is a level proportional to VSR/VSF, and is used to drive the SWR meter and also for AT-940 control purposes. VR18 is an SWR meter adjust for initial setup only.

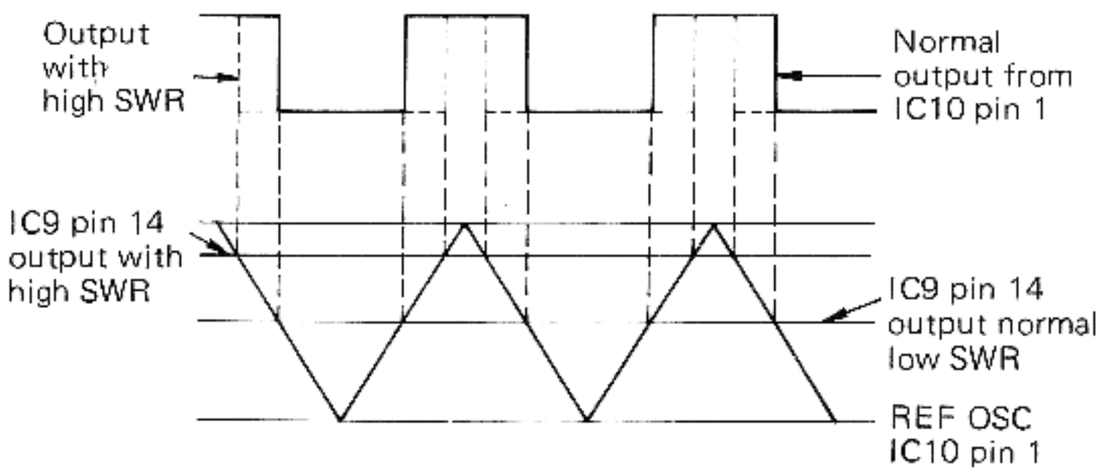


**Fig.17**

- **Timing circuit**

The TS-940 has five kinds of timing signals for switching between transmission and reception; TV, RV, TR, TBK and ALC. **Fig. 18** shows the timing relationship between there signals. This is the timing chart for SSB, MF, FSK and CW full break-in keying. The timing charts for CW keying in the CW semi-break-in and standby modes are shown in **Fig. 19**, (a) and (b).

TV and RV are the supply voltage to be applied to each of the various transmitter and receiver channel circuits. A pause of approx. 3ms is designed between the switching of each voltage.

The transient state of each circuit stabilizes within this period. The TR live information the PLL channel of the transmit/receive status, and is used to switch transmitter and receiver frequencies during "cross band" mode operation. the transient state of this signal is also stabilized within the 3ms pause time.

TBK is the keying signal in the CW operating mode. This signal is allowed to pass through the active low filter to eliminate any key click component and then, the output is used to generate ALC voltage. Therefore, ALC voltage is used not only for controlling the transmitter output, but also for output keying in the CW mode.

In modes other than CW, output keying is unnecessary, but the timing remains the same. **Fig. 19**, (a) and (b) give the timing charts for CW semi-break-in operation and CW mode with just the standby switch. If Fig. 19, the timing of RV, TR, etc. are omitted, as they are the same as those in **Fig. 18.**

The trailing edge of TV is approx. 6ms after that of TBK. During this period, the transmitter output breaks together with ALC voltage. TB and RB are the transmitter and receiver channel bias voltage ; the timing is synchronized with the TV signal. RB is inverted. **Fig. 20** gives the basic block diagram to generate each of these timing signal previsouly discussed.

**Fig. 21** shows the operating timing chart in this configuration. The actual operation of the timing chart will now be described. (See **Fig. 22** "Block diagram")

This circuit is operated by the keying input, standby switch (PTT) input, VOX input, ANTI-VOX input, etc. In the block diagram (**Fig. 22**), STBY SW Gate 3 (IC1 4/4) opens (D30, goes Hi) only at keying by the standby switch in CW mode. Operation by the standby switch in modes other than CW makes transistor Q6 turn off as D26 drops to GND in send mode. Thus, a high voltage is applied to inverter IC3 2/6 via D31. (In CW mode, since the cathode of D27 becomes low, a high voltage is not applied to D31.)

# CIRCUIT DESCRIPTION

When the VOX is on, a high voltage is applied to inverter IC3 2/6 from the one-shot multivibrator via D4. (The VOX circuit is explained in a following section.) The output of inverter IC3 2/6 (pin 6) goes low, the cathode of D14 becomes low, and TR switching transistor Q7 turns off.
Thus, a high voltage is supplied to the TR terminal via D9. (**Fig. 18**– Ⓐ ) (As Q7 is on in the receive mode, the TR terminal is low.)
At the same time, the RV AND gate 5 (IC4 2/3), pin 4 goes low (TX protection OFF → BTR terminal L), the output terminal, pin 6 becomes low and the RV switching circuit (Q30, Q28) turns off.
Therefore, as soon as the transistor level becomes high RV voltage level becomes low. (**Fig. 18**– Ⓑ )
The output of inverter IC3 2/6 enters the delay circuit I composed of IC1 3/4, R29 and C13. The output signal delayed approx. 3ms (H level) is applied to IC1 3/4, pin 4. (**Fig. 18**– Ⓒ ). This signal becomes the TBK keying signal in the CW operating mode.
When the TBK signal is applied to the YV gate IC4 3/3 (pin 13) via Q24, a TV switchihg signal synchronized with the leading edge of the TBK voltage is generated at pin 10 as an output. At this time, as the RV gate output (IC4 2/3, pin 6) is at low level (D21 is off), IC4 2/3, pin 12 is at high level, like the output of inverter IC3 6/6. IC4 3/3, pin 11 is usually at high level when the PLL is in the lock states.
When this signal (IC3 3/3, pin 10) is applied to the TV switching circuit, a TV voltage is generated. (See **Fig. 22**, "Block diagram".)
Based on the TV voltage, an in-phase TB voltage and inverted RB voltage are generated. (**Fig. 18**– Ⓓ and Ⓔ ).
The leading edge (RX → TX) of the timing circuit will now be discussed. When the key is up in the CW operating mode, as the output (pin 13) of the STBY switch gate 3 changes from high to low level and the output (pin 3) of gate 2 changes from low to high level, the output (pin 10) of one-shot multivibrator IC2 3/4 goes low and D4 turns off.
Since the cathode of D27 is at low level due to the CWG signal, the anode of D31 is held at low level, i.e., D4, D30 and D31 turn off. Thus, the input to inverter IC3 2/6 changes from high to low level, and the output of IC3 2/6, pin 6 changes from low to high level. When the VOX turns off during VOX operation or the standby switch is set to the REC position, the output of inverter IC3 2/6 becomes high level as in the previous narrative.
This signal is applied to the delay circuit I and after 3ms. The TBK line voltage breaks. (**Fig. 18**– Ⓕ )
TBK voltage is inverted by inverter IC3 3/6, and is used to change the input signal level of BK gate 7 (IC4 1/3, pin 8) from low to high.
Since pin 2 is at high level at break-in, gate 7 changes the output level at pin 9 from low to high at the trailing edge of the TBK timing signal. During semi-break-in, since pin 2 is held low during the delay time, output pin 9 changes from a low to a high level stage after the delay. At this time, the BK gate 7, pin 1 is high because the key is up. The BK gate 7 output signal is applied to delay circuit II and after approx. 5ms, the signal becomes low level, and D23 turns off to change the TV gate 6, pin 13 from a high to a low logic level. Therefore, the output (pin 10) of TV gate 6 changes from high to low, and the TV voltage is lowered. (**Fig. 18**– Ⓖ )
At the same time, the TB voltage breaks and inversely, the RB voltage rises. (**Fig. 18**– Ⓘ and Ⓙ ) In addition, as the TV voltage being supplied from D36 to the TR line breaks at the same time, the TR voltage changes from high to low level. (**Fig. 18**– Ⓗ )
Further, the output signal of delay circuit II is applied to the integrating circuit of delay circuit III, where it becomes a 3ms delayed signal, and this output changes the RV gate 5, pin 3 from a low to a high logic level. (At this time, pin 4 and pin 5 are high level.) Thus, the output of RV gate 5 changes from low to high and RV voltage rises. (**Fig. 18**– Ⓚ ) When a temperature protection signal or band protection signal are applied from the filter unit to the BTP terminal, the RV switching circuit functions via D21 and generates RV voltage. At the same time as TV gate 6, pin 12 is changed from high to low level by inverter IC3 6/6, the output signal level is also changed from high to low and the TV switching circuit turns off. Thus, TV voltage drops and the transceiver goes into the receiving state.

- **VOX, ANTI-VOX circuit (provided on the Control unit)**

In **Fig. 22**, "Timing circuit configuration", the MIC preamplifier output is applied to the VXZ terminal on the Control unit via the VOX gain control, amplified by VOX amplifier Q1~Q3 and applied to the following stage R-S flip-flop (IC1 1/4, pin 13). On the other hand, the AF output signal (SP2 signal) from the speaker is applied to ANTI-VOX amplifier Q10, Q11 to be DC rectification, and this output is applied the R-S flip-flop IC1 2/4, pin 9.
By using this logic function, the faster input either VOX or ANTI-VOX, is given priority. When the VOX input is given priority, a signal pulse is applied to VOX gate 1 (IC2 1/4, pin 12) and the gate is opened. However, gate 1, pin 13 is high when the VOX switch is on in SSB, FM or AM mode. When ANTI-VOX is given priority, VOX gate 1 (IC2 1/4, pin 12) is low and the gate is closed.
In CW mode, the STK terminal signal (low at key down) is applied to VOX gate 2 (IC2 2/4, pin 2) after being switched by Q9. thus, a high level signal is applied to VOX gate 2 (IC2 2/4, pin 2) and the gate is opened when the key closed. Gate 2, pin 1 is high when the VOX switch is on in CW mode. Gate 1 or 2 signal goes through one-shot multivibrator IC2 3/4 and IC3 1/6 and enters the VOX Delay circuit composed of C9, R18 and Q4, where the VOX hold time is established. Use of this type of logic circuitry increases response the speed of the VOX and eliminates VOX/ANTI-VOX cycling.

# CIRCUIT DESCRIPTION

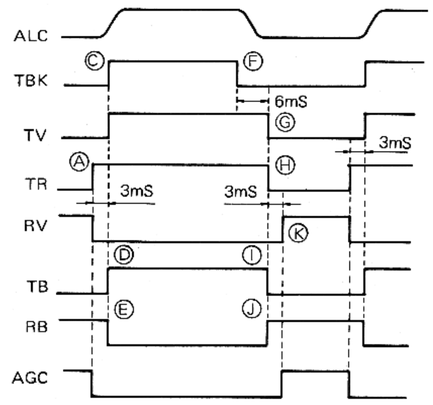


**Fig. 18 T-R timing chart (CW full break-in, SSB, FSK and TUNE modes)**

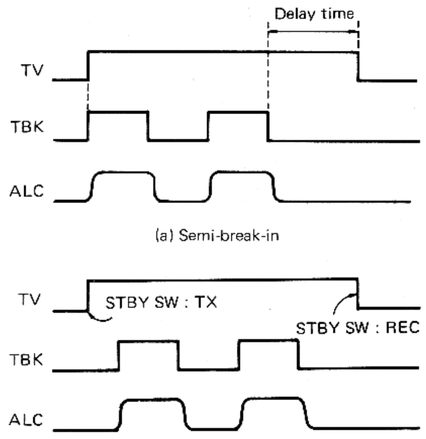


**Fig. 19 CW operation timing chart**

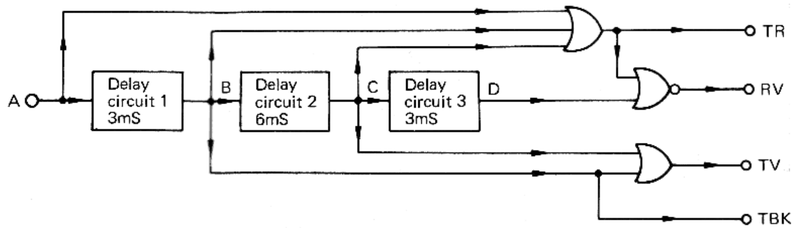


**Fig. 20 Timing circuit basic block diagram**

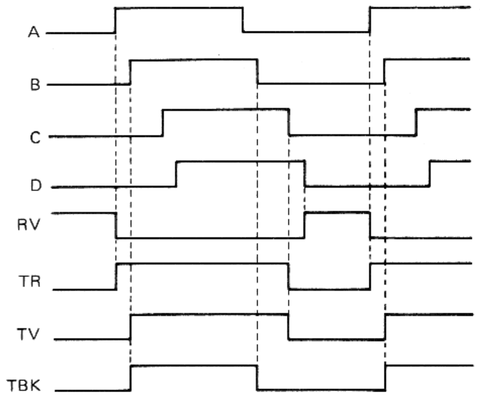


**Fig. 21**

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RadioAmateur.EU

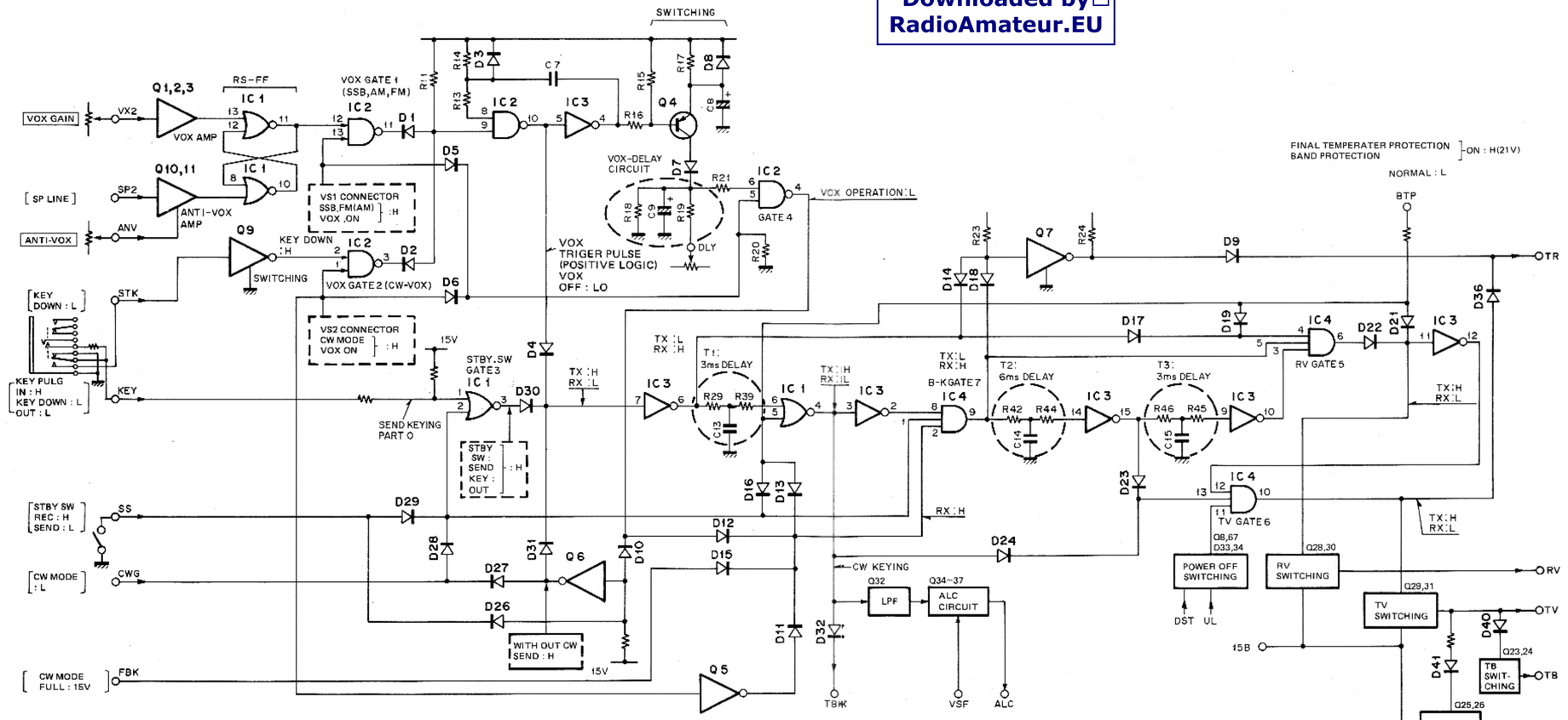



**Fig. 22 Timing circuit block diagram**

## CIRCUIT DESCRIPTION

- **Antenna tuner**

The block diagram is shown in **Fig. 23**. The AT-940 operates in the 1.8–29MHz bands and is automatically adjusted so that the SWR becomes 1.2 : 1 or less. For smooth antenna tuning, the mode is stored before antenna tuning and set again after tuning. **Fig. 26** shows the antenna tuner timing chart.

The AUTO-THRU relay protective circuit (Q120, Q121, 122, 123 and 126) holds the AUTO-THRU relay condition during transmission. This circuit monitors the AUTO-THRU switch condition and the TV line (Transmit-high level/receiver-low level) and allows a change in the AUTO-THRU switch to affect the relay condition only when the TS-940 is in the receiver mode.

A change in the AUTO-THRU switch during transmission change the relay only after the TS-940 returns to recieve. (See **Fig. 24** "Relay protection circuit diagram.)

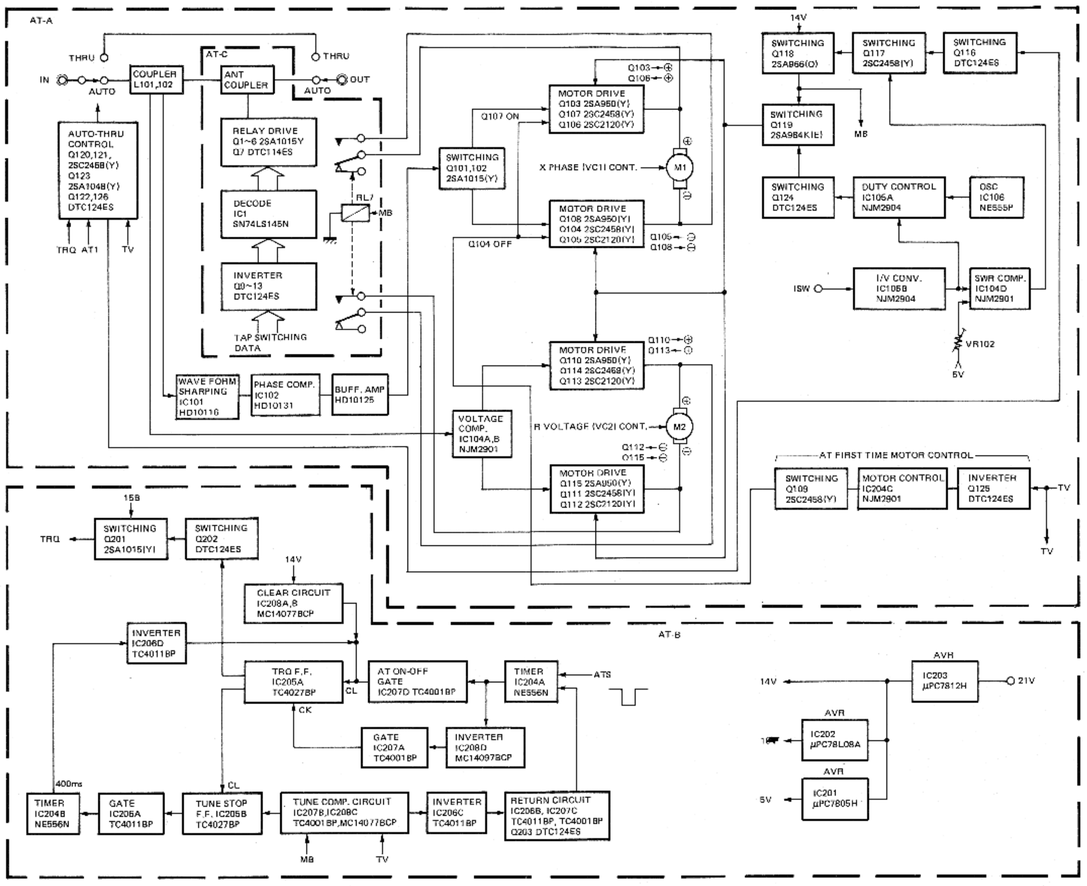
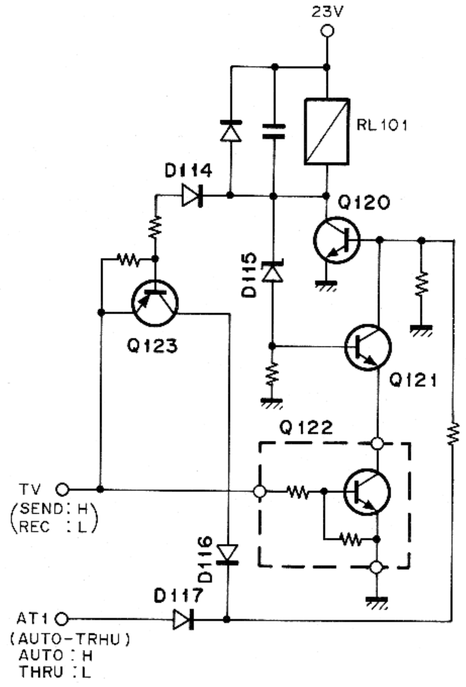



**Fig. 23 AT unit block diagram**




| | | | |
|---|---|---|---|
| REC | Q122 : OFF | Q120 : OFF | RL101 : OFF |
| | Q121 : OFF | Q123 : OFF | |
| ↓ | | | |
| AUTO-THRU | Q120 : ON | | RL101 : ON |
| AUTO | | | |
| ↓ | | | |
| STBY SW | Q122 : OFF | Q123 : ON | |
| SEND | Q121 : OFF | Q120 : ON | RL101 : ON |
| ↓ | (Relay protection operation) | | |
| AUTO-THRU | Q122 : OFF | Q123 : ON | |
| THRU | Q121 : OFF | Q120 : ON | RL101 : ON |
| ↓ | | | |
| STBY SW | Q122 : OFF | Q123 : OFF | |
| REC | Q121 : OFF | Q120 : OFF | RL101 : OFF |
| ↓ | | | |
| STBY SW | Q122 : ON | Q123 : OFF | |
| SEND | Q121 : ON | Q120 : OFF | RL101 : OFF |
| ↓ | (Relay protection operation) | | |
| AUTO-THRU | Q122 : ON | Q123 : OFF | RL101 : OFF |
| AUTO | Q121 : ON | Q120 : OFF | |

**Fig. 24 Relay protection circuit diagram**

## CIRCUIT DESCRIPTION

To operate, the AUTO-THRU switch must be set to the AUTO position. when the ATT switch is pressed, the antenna tuner start pulse (At start pulse) of 40–50μs, from the digital unit A microprocessor, triggers the AT-B unit timer IC204a (pin 6) generating an approx. 3 second pulse. Through inverter IC208d and gate IC207a, this pulse clocks JK flip-flop IC205a at pin 3 so that the pin 1 output level toggles from low to high (approx. 14V). A clear pulse, generated by IC205a and b when the power switch is tunred on, sets IC205a pin 1 to its initial low level. The IC205a pin 1 high level turns on Q202 and Q201 to switch approx. 15V to the TRQ terminal (AT ready signal.)

At this AT Ready state, the microprocessor sets tune mode (MODE LED goes out) and, at the same time, the power down circuit for setting the power to 50W operates (in the Control unit)

If, during the 3 second timer operation, the STBY (or mic. PTT) switch is not set to the SEND position, gate IC207d switches at the trailing edge of the timer and clears IC205a (pin 4). This sets the pin1 output to a low level which switches the TRQ terminal to a low level. When the TRQ terminal goes low, the microprocessor returns the radio to the original mode and the power down circuit is released. (**Fig. 26**– Ⓐ )

If during this 3 second period, the STBY switch is set to the send position, the TV line goes high at IC207d input pin 13.

The gate closes and the IC205a pin 1 output is held high. At that time, the antenna tuner circuit starts tuning. When tuning is finished, the capacitor variable antenna coupler motor stops. This state is monitored at the MB terminal and JK flip-flop : IC205b is toggles to a high level by the gates IC208c and IC207b.

This flip-flop is in the clear state when the AT Ready signal is not generated. Gate IC206a detect the leading edge of this JK flip-flop signal and triggers another timer (IC204b). IC206d detects the trailing edge of this approx. 400ms pulse and clears IC205a at pin 4.

This starts the sequence of the TRQ terminal switching to a low level, the microprocessor restoring the mode, the power down circuit being released, and completion of tuning. (**Fig. 26**– Ⓑ )

The timer IC204b works as a tuning delay circuit when a momentary rattling of the motor stop realy occrus.

If the STBY switch is set to the REC position during the tuning operaiton, the AT Ready signal is generated for three seconds. The tuning operaiton is started if the STBY switch is again set to the SEND position.

The MB and TV terminals are monitored by IC206c, IC206b and IC207c and when these terminal levels are changed quickly from high to low (when the STBY switch is set to the REC position before the tuning operation is finished), the first timer (IC204a) is again triggered to operate. Therefore, when the STBY switch is held in the REC position for more than 3 seconds, the AT Ready signal goes low and the original mode is returned. (**Fig. 26**– Ⓒ )

# CIRCUIT DESCRIPTION

The antenna tuning circuit is explained next. When the AUTO-THRU selector switch is set to the AUTO position, the ATT switch is pressed and the STBY switch is set to the SEND position, transmit power is supplied from the final via the Filter unit. It passes through the current and voltage detecting transformers (L101 and L102) which use toroidal cores. the current and voltage components are applied to IC101 (pins 9 and 13) and waveform shaped. The output signal is applied to IC102 (D type master-slave flip-flop), where the phase is compared. The output of IC102 (pin 14) runs through the buffer IC103 (pins 10 and 15) and switches the emitter coupled circuit Q101 and Q102

The motor driving circuit Q103–Q108 is operated by this ON-OFF signal, and the variable capacitor (VC1) is rotated forward or backward by the motor M1. The current and voltage components from L101 and L102 are also applied to the voltage comparator IC104a and b (pins 6 and 4), and the output operates the motor driving circuit Q110–Q115 so that the variable capacitor (VC2) is rotated forward or backward by the motor M2 to minimize the amplitude difference.

Therefore, the phase control variable capacitor (VC1) is controlled so that the phases of current and voltage coincide with each other. The voltage control variable capacitor (VC2) is controlled so that the amplitude difference between current and voltage is minimized. (SWR1 with coincidental phases and zero amplitude difference)

VC1 and VC2 are designed to rotate independently. However, since the phase and voltage influence each other, the voltage changes as the phase is changed and the rotations of VC1 and VC2 change accordingly. Also the forward and reflected wave detected in the Filter unit are applied to the Control unit SWR arithmetic circuit, from which they are sent to the AT-A unit ISW terminal as an SWR signal.

this SWR signal is in the currnet mode and is converted in the AT-A unit (IC105b) to make an SWR signal of voltage mode. The signal is then applied to the SWR comparator IC104d (pin 9). The voltage equivalent to SWR 1.2 : 1 is applied to the reference voltage terminal (IC104d, pin 8) through the semi-fixed resistor. Thus, when the SWR is greater than 1.2 : 1 the IC104d output terminal (pin 14) is high and switch Q118 turns the motor voltage supply on. The motor driving circuit is actuated. When the SWR is lowered to below 1.2 : 1 the output terminal (pin 14) of IC104d switches to low, and the switching transistors Q117 and Q118 turn off (motor stop signal), the motor driving circuit turns off and the motor stops.

High motor speed is desired for fast antenna tuning. However, this can cause the match point of SWR less than 1.2 : 1 to be overrun due to increased inertia, the capacitors reversing and tuning past the match point continuously. A slower speed prolonges the operation. Therefore, the TS-940 uses the following method to vary the speed with the SWR. That is, faster with an SWR increase, and slower with an SWR reduction.

The SWR signal sent to the SWR comparator IC104d is also sent to the variable duty motor voltage circuit (IC105a, pin 5). The variable duty circuit uses timer IC106 as a triangle wave oscillator andits outputis applied comparator (IC105a, pin 6) to vary the duty of the output pulse (pin 7). (**Fig. 25**)

Therefore, when the SWR is higher than 5 : 1, the motor driving voltage is at 100% duty, and the motor rotates at high speed. When the SWR value is lowered to 2 : 1, the duty ratio is also lowered (50%) and the motor speed becomes low. As soon as the SWR lowers to below 1.2 : 1 and the motor driving voltage disappears, the motor brake circuit RL7 operates to immediately stop the motor rotation.

The antenna coupler of the TS-940 is a T type and the tap positions from 1.8MHz to 30MHz are switched by eight relays (RL1–6 and 8). The tap switching data is given in **Table 19**.

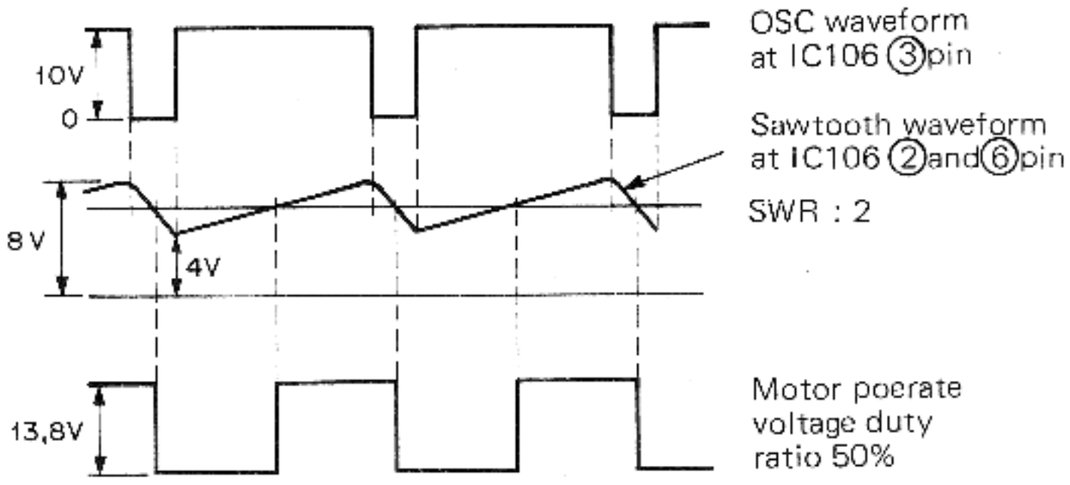
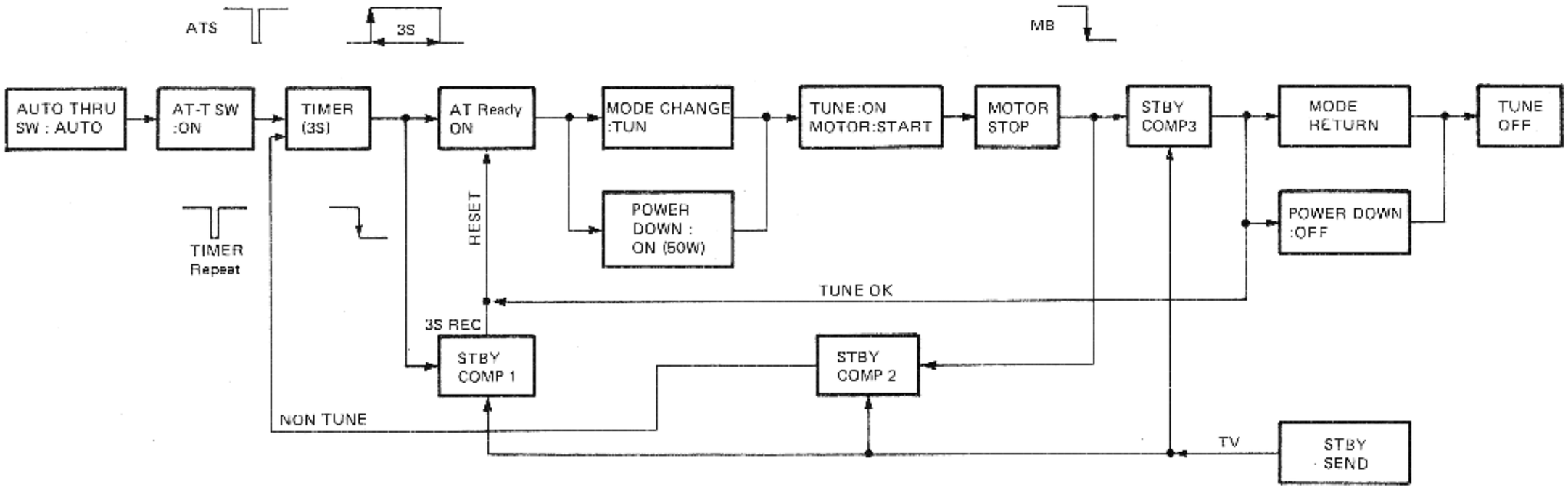



**Fig. 25 Tuning motor speed control**

| BAND | WRC | AT0 | AT1 | AT2 | AT3 | RL1 | RL2 | RL3 | RL4 | RL5 | RL6 | RL8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.8 | 0 | 1 | 0 | 1 | 1 | ○ | ○ | ○ | ○ | | | |
| 3.5 | 0 | 0 | 0 | 1 | 1 | | ○ | ○ | ○ | | | |
| 7 | 0 | 0 | 1 | 0 | 1 | | | ○ | ○ | | | |
| 10 | 1 | 1 | 0 | 0 | 1 | | | | ○ | | | |
| 14 | 0 | 0 | 0 | 0 | 1 | | | | | | | |
| 18 | 1 | 1 | 1 | 1 | 0 | | | | | ○ | | |
| 21 | 0 | 1 | 1 | 1 | 0 | | | | | ○ | | |
| 24.5 | 1 | 0 | 1 | 1 | 0 | | | | | | ○ | |
| 28 | 0 | 0 | 1 | 1 | 0 | | | | | | ○ | ○ |

**Table 19 AT tuner band selection data**

# CIRCUIT DESCRIPTION



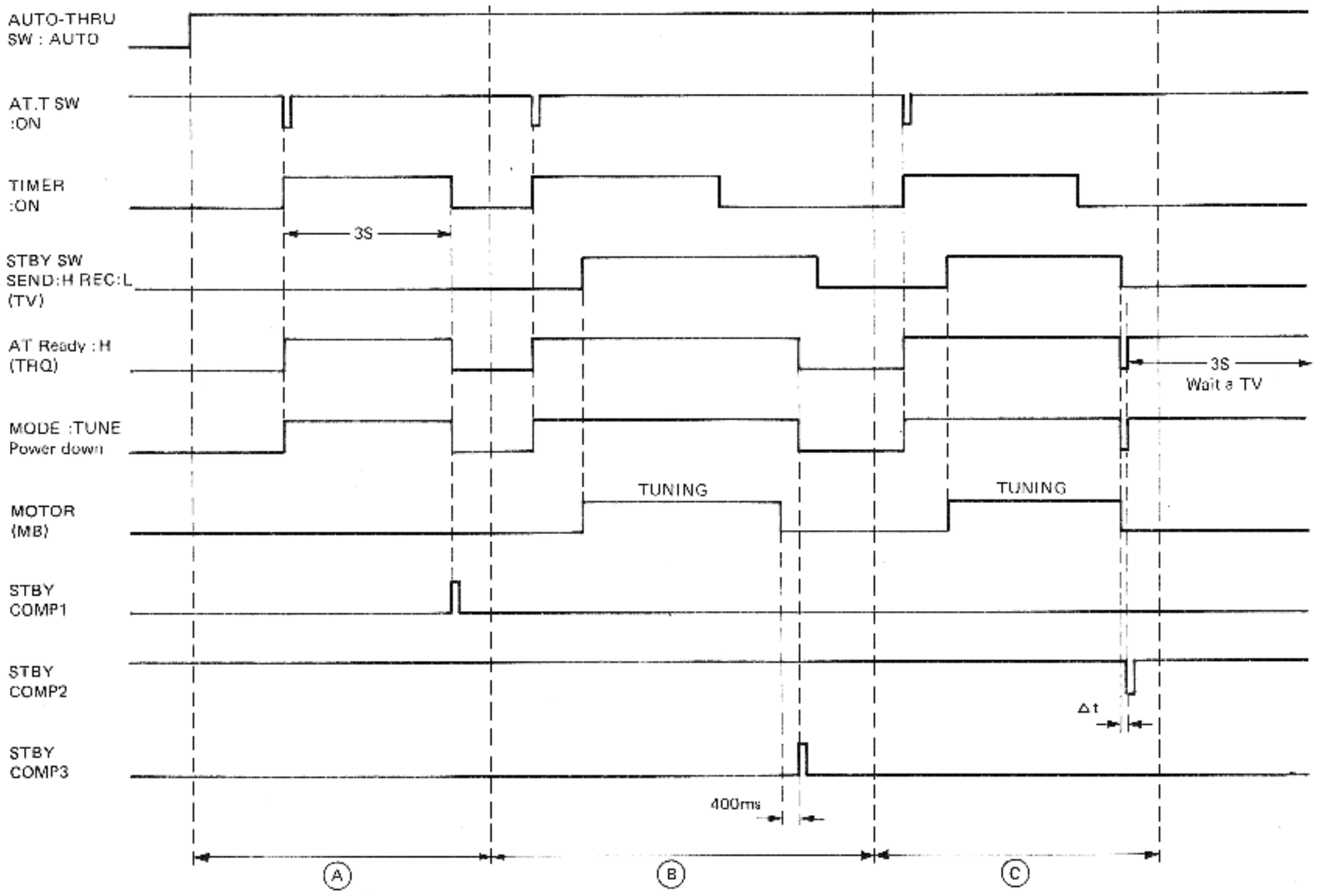




Fig. 26 AT tuner timing chart

# CIRCUIT DESCRIPTION

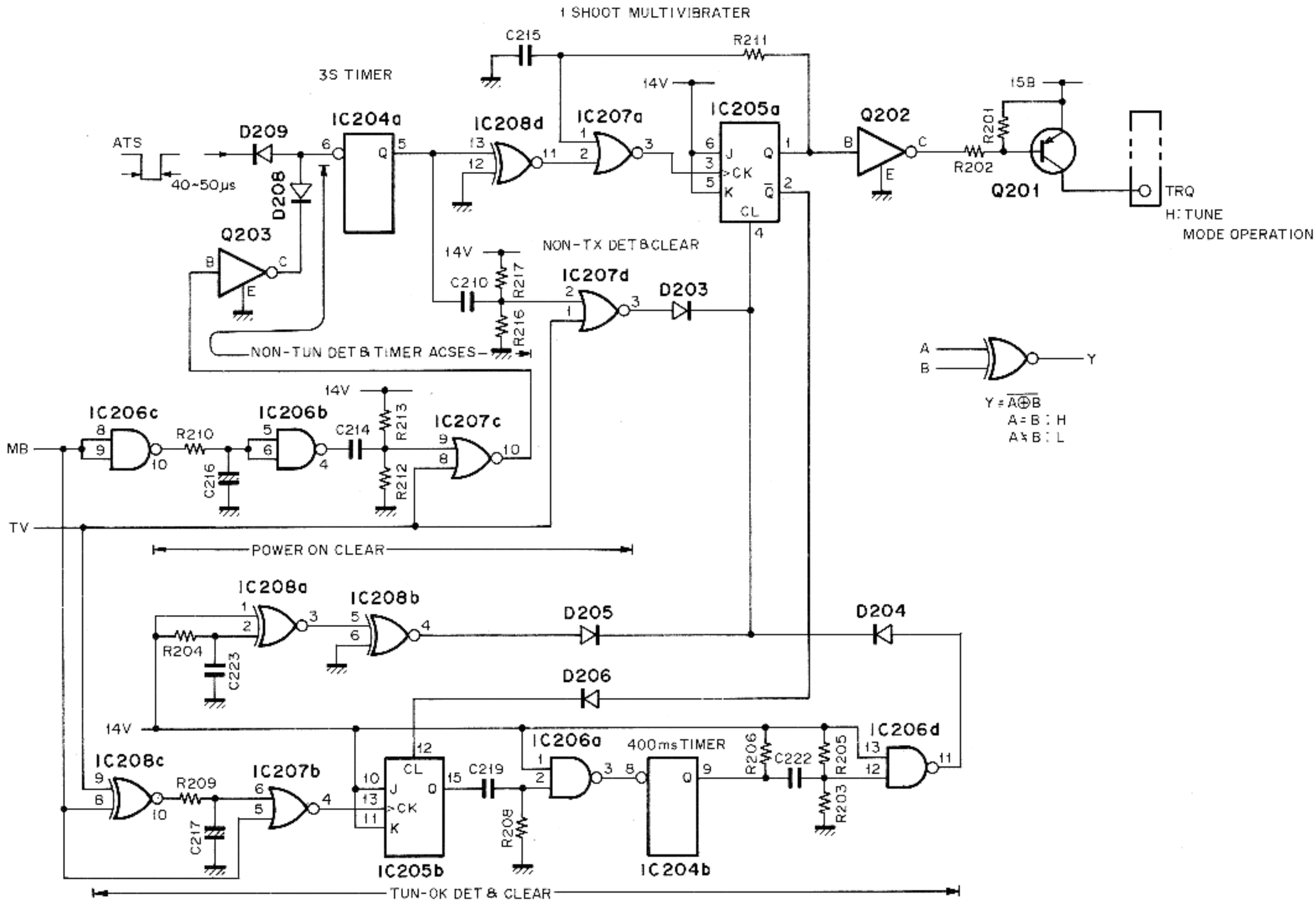



**Fig. 27 AT tuner operate detection**

## Digital Circuit

As shown by the block diagram in **Fig. 28**, the digital control section is the heart of the TS-940 and controls all its units. The digital section consists of the Digital A unit (X54-1830-00), Digital B unit (X54-1840-00 B/2), Digital C unit (X54-1850-00), DC-DC unit (X46-1030-00), Switch unit (X41-1600-00), Main Encoder ass'y (W02-0328-10), RIT Encoder unit (X54-1690-01) and Keyboard ass'y (S59-0433-05), a total of units. The TS-940 is capable of versatile functions, using the latest microprocessor technology. Consequently, about 50 data for the input and about 70 data for the output are handled, requiring an input/output function with much greater capacity than conventional models. To meet this requirement, the microprocessor has an 8-bit multichip construction designed to minimize the number of ICs used : the input/output uses a series of three I/O control ICs 8255 and three LC7800 (Sanyo) are used for multiplexing the input signal for the input data.
Separate descriptions for each unit now follow.

# CIRCUIT DESCRIPTION

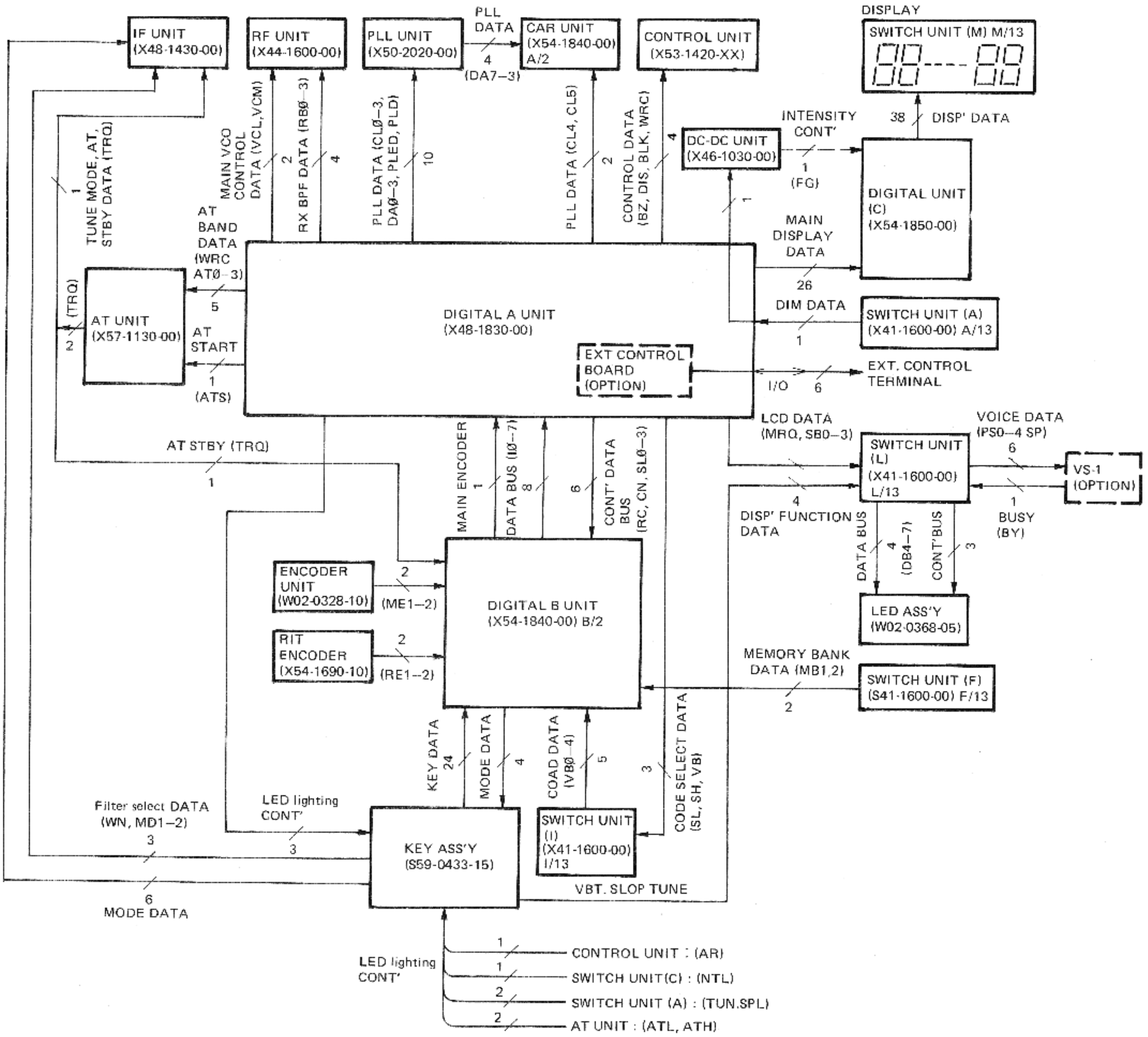



**Fig. 28 Digital control block diagram**

1) Digital B unit

This unit performs multiplexing of the input, waveform shaping of encoder pulses and detection of AT In/Through (detection of the presence of the AT unit in export models.) The input SW data in the Digital B unit goes to ICs 109, 110 and 111, selected by the port select signal from the Digital A unit, and supplied to the Digital A unit.

As with the TS-930, two optical encoders, for the main VFO and for RIT, are provided. Each converts one dial rotation into pulses and shapes the waveform. In the main encoder, 250 pulses are converted to 1000 pulses; one rotation corresponds to the encoder signal of 10kHz with a resolution of 10Hz. In the fast tuning mode with more than 2 or 3 rotations per second, the variation of frequency progressively increases thanks to a "speed-up" function. (Main encoder ICs 101, 102, 103, 2/4, IC7. RIT encoder ICs 104, 105, 106, 2/4, 107.)

# CIRCUIT DESCRIPTION

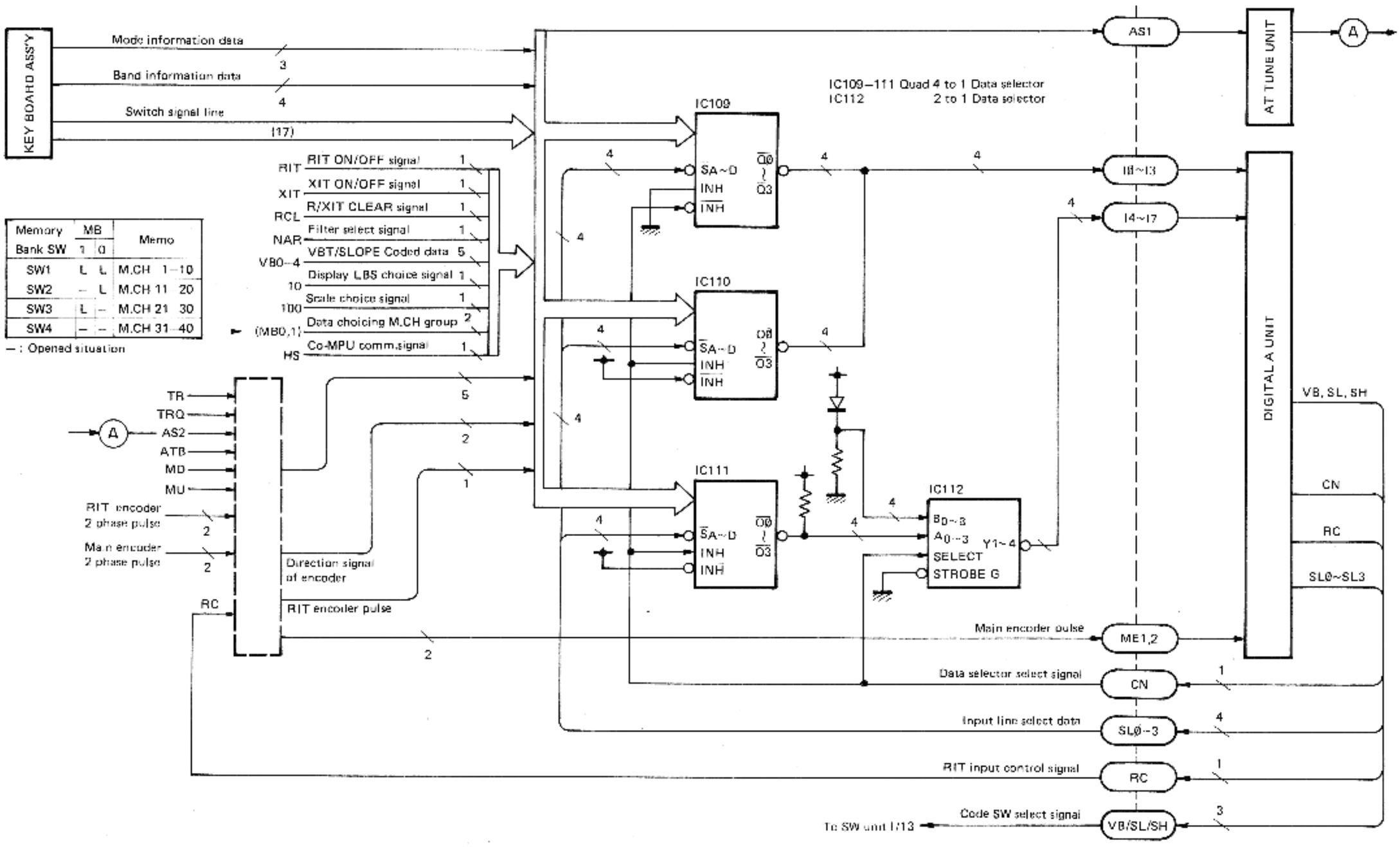



**Fig. 29 Digital-B unit block diagram**

## 2) Digital C unit

This unit is used to drive the fluorescent display tube along with the analog dial scale.

As the display data supplied from the Digital A unit has TTL level voltage, the display tube cannot be directly driven. To light the display tube, the drive voltages (heater voltage and display tube drive voltage) from the DC-DC unit is used together with the control data. The display data consists of time-division multiplexing of three data ; the 7-segment data for digits, indicator data such as VFOA, MEMO, RIT, etc., and analog dial scale data. These data are also separated at this occasion.

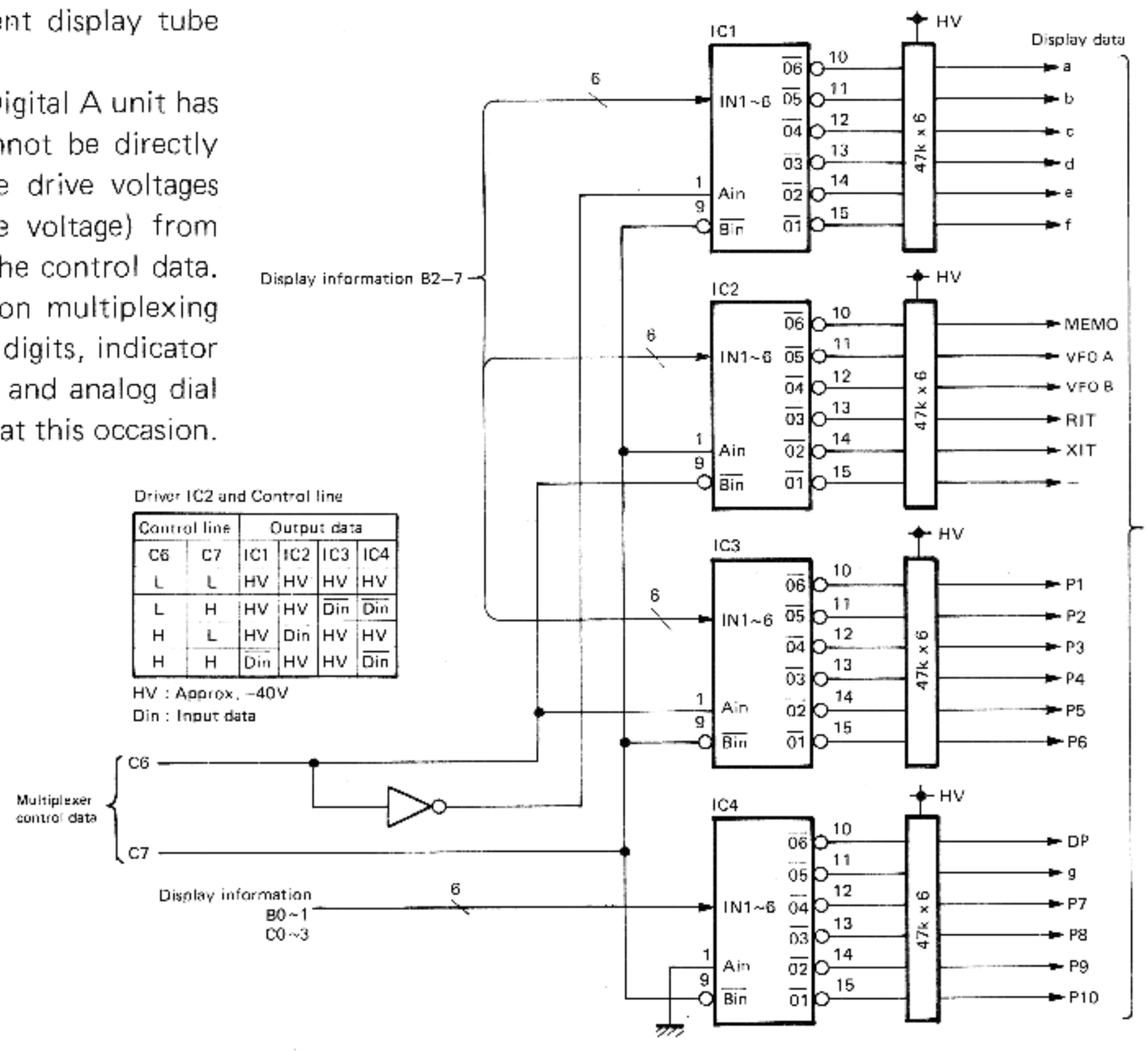



**Fig. 30 Dispaly data**

# CIRCUIT DESCRIPTION

3) DC-DC unit

This unit generates the filament voltage for driving the fluorescent tube and the negative high voltage.

The 21V voltage from the Control unit is converted into —40V by the DC-DC converter.

4) Main Encoder ass'y and RIT Encoder unit

These optical encoders consisting of photoetched disks slit, and a photo-interrupter, both output 2-phase pulses with a phase difference of 90°C. The direction of rotation is judged from this phase difference.

5) Switch unit

Description will be given for the circuitry around the liquid crystal display (hereafter abbreviated LCD.) The TS-940 uses a dual-display system using a newly-developed dot matrix LCD, in addition to a fluorescent tube : in addition to the operating frequency, the display can be switched for the frequency and mode of the alternate VFO, frequencies and modes of the memory channels, bandwidth of VBT/ SLOPE TUNE systems, and clock/timer display. The LCD ass'y consists of the dot matrix LCD and drive IC and is driven from the 4 bit/8 bit data bus. A new 4 bit microprocessor is used for this model and interfacing to the drive IC is performed in 4 bits. The 4 bit microprocessor performs operations such as switching of the display mode, setting of the clock and timer, switching of various displays, data communication with the main microprocessor, outputting of the audio data output from the optional voice synthesizer unit (VS-1), etc.

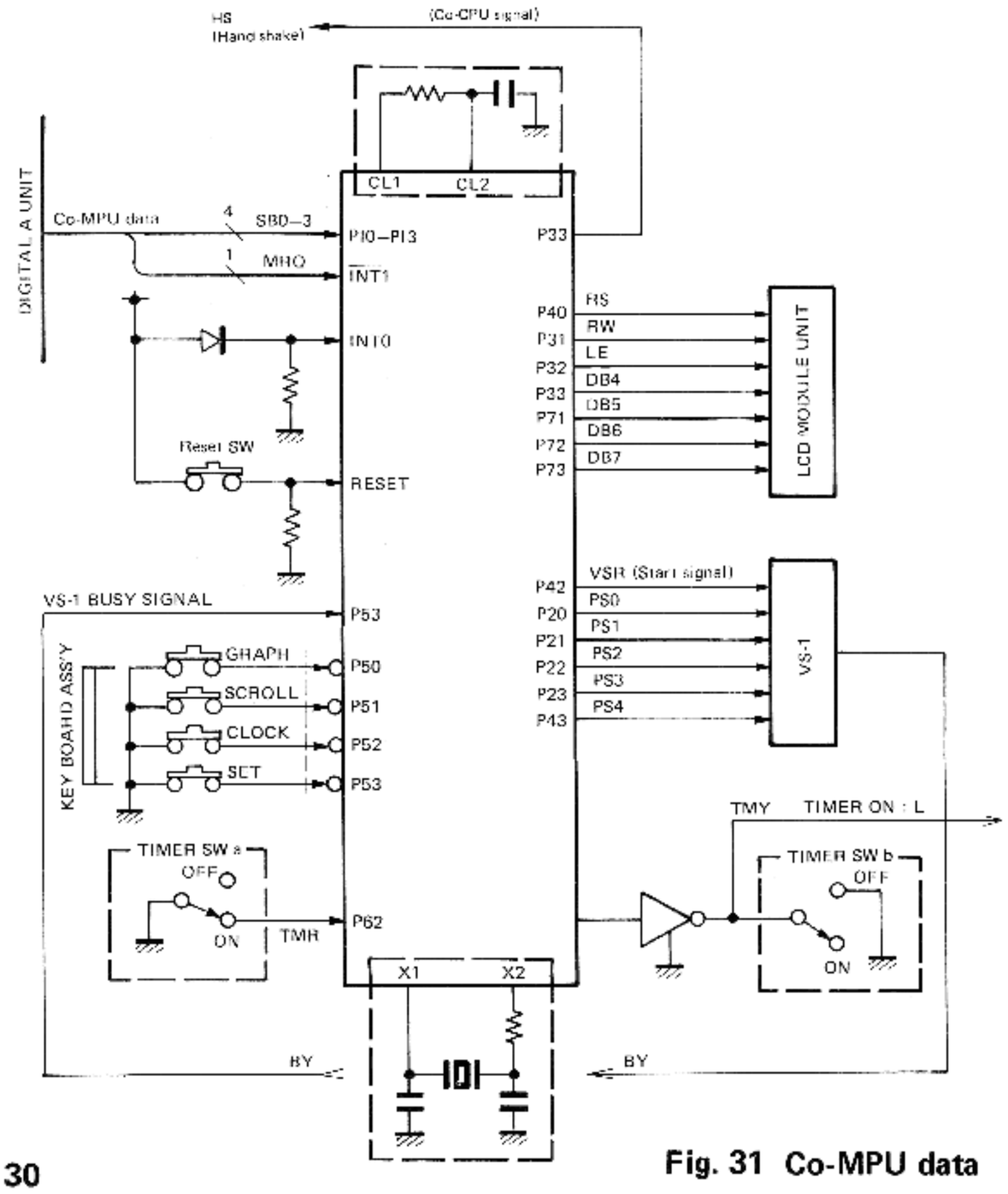



**Fig. 31 Co-MPU data**

6) Digital A unit

This unit is the control center of units 1) to 5) and for data communications between them. It has a multitip 8-bit construction and the CPU uses a Z-80 operated at a clock rate of 2.5MHz.

The main memory has a large 8-kByte capacity and the 2-kByte RAM backs up several data including the 40-ch memory data, VFO data, RIT frequency, and ON/OFF condition using a lithium battery. The backup timing is controlled by the system reset IC (IC20, PST5184), which interrupts execution at the instant the supply voltage falls below 4.2V to activate the backup mode. (**Fig. 32**)

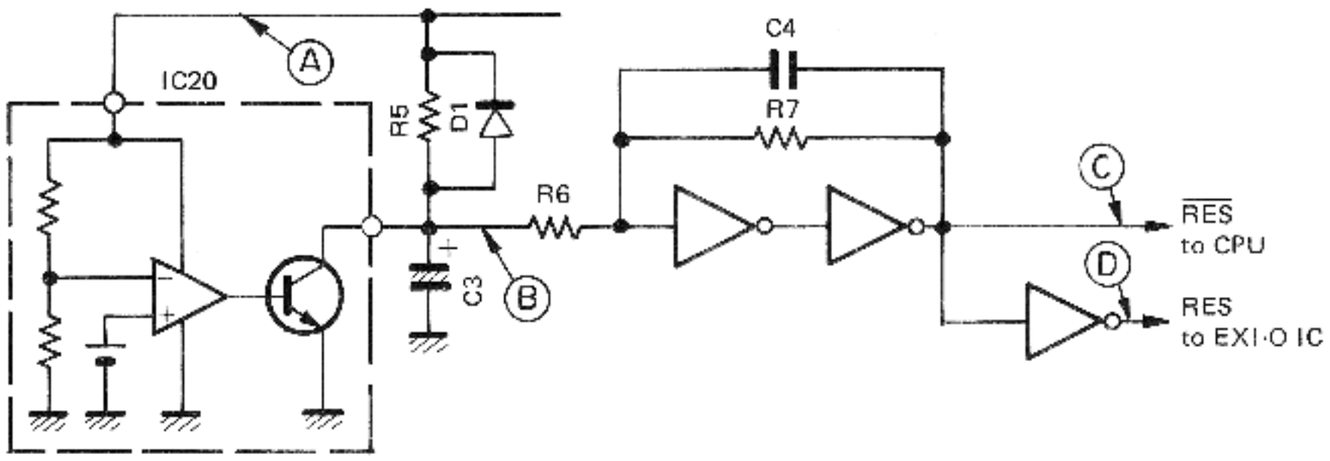
The I/O system uses the memory-mapped I/O system : the 1st 8255 outputs the display data : the 2nd 8255 outputs the AT band data, LPF band data, data outputs for the three main loop PLL ICs and data outputs for the two carrier PLL ICs ; and the 3rd 8255 inputs the switch data and outputs the switch data output and the outputs for the LEDs.

The terminals for the RX bandpass data output and LCD-use submicroprocessor data output are also provided by using the latch output method.

For the antenna tuner standby operation, the AT In/Through condition (and also the presence of an AT in export models) is judged when the ATT SW is pressed : when the condition is OK, the AT standby pulse (active low, about 100μs) is output to the AT unit, which then stands by and sends back the AT Ready signal.

The microprocessor detects this Ready signal, automatically changes the mode to TUN. The mode changes back to the previous mode when tuning is complete. The AT coupler is always supplied with current band data for band switching. (**Fig. 35**) The standby signal is also supplied to the submicroprocessor so that the AT standby message is also output on the sub display. Other circuits used include the mode announce circuit (which indicates the switching of mode by CW codes) the PLL noise blanking circuit which suppresses noise during PLL reset pulse, and the "beep" sound control circuit which indicates when the various tactile switches are pressed.

# CIRCUIT DESCRIPTION



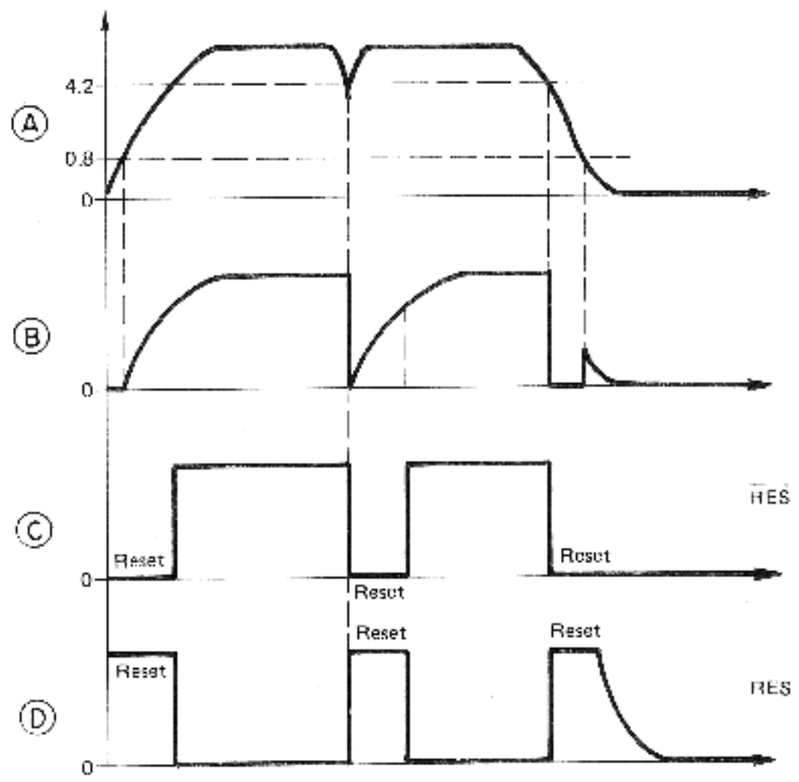




**Fig. 32 Reset circuit**

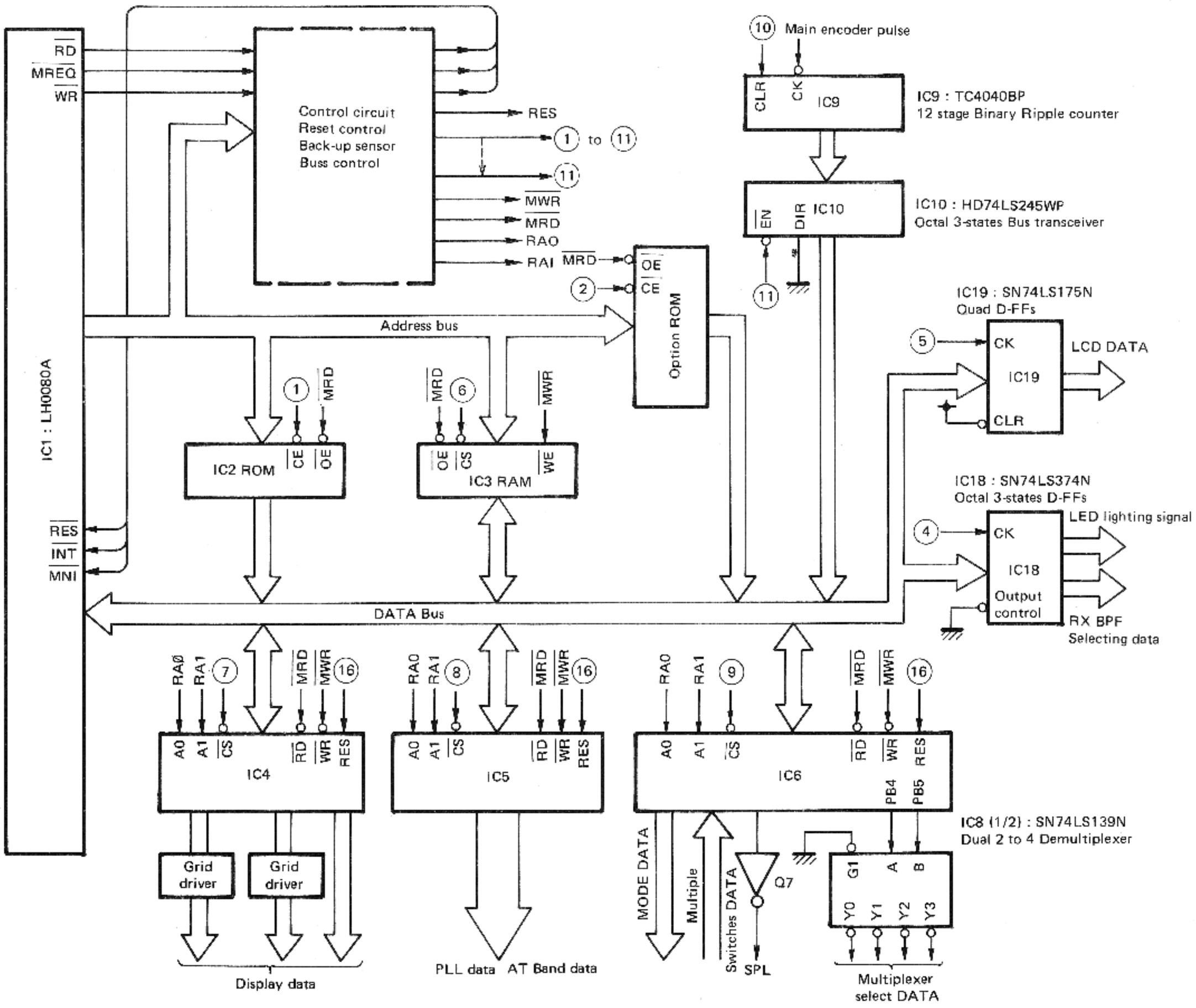



**Fig. 33 Digital-A unit block diagram**

# CIRCUIT DESCRIPTION

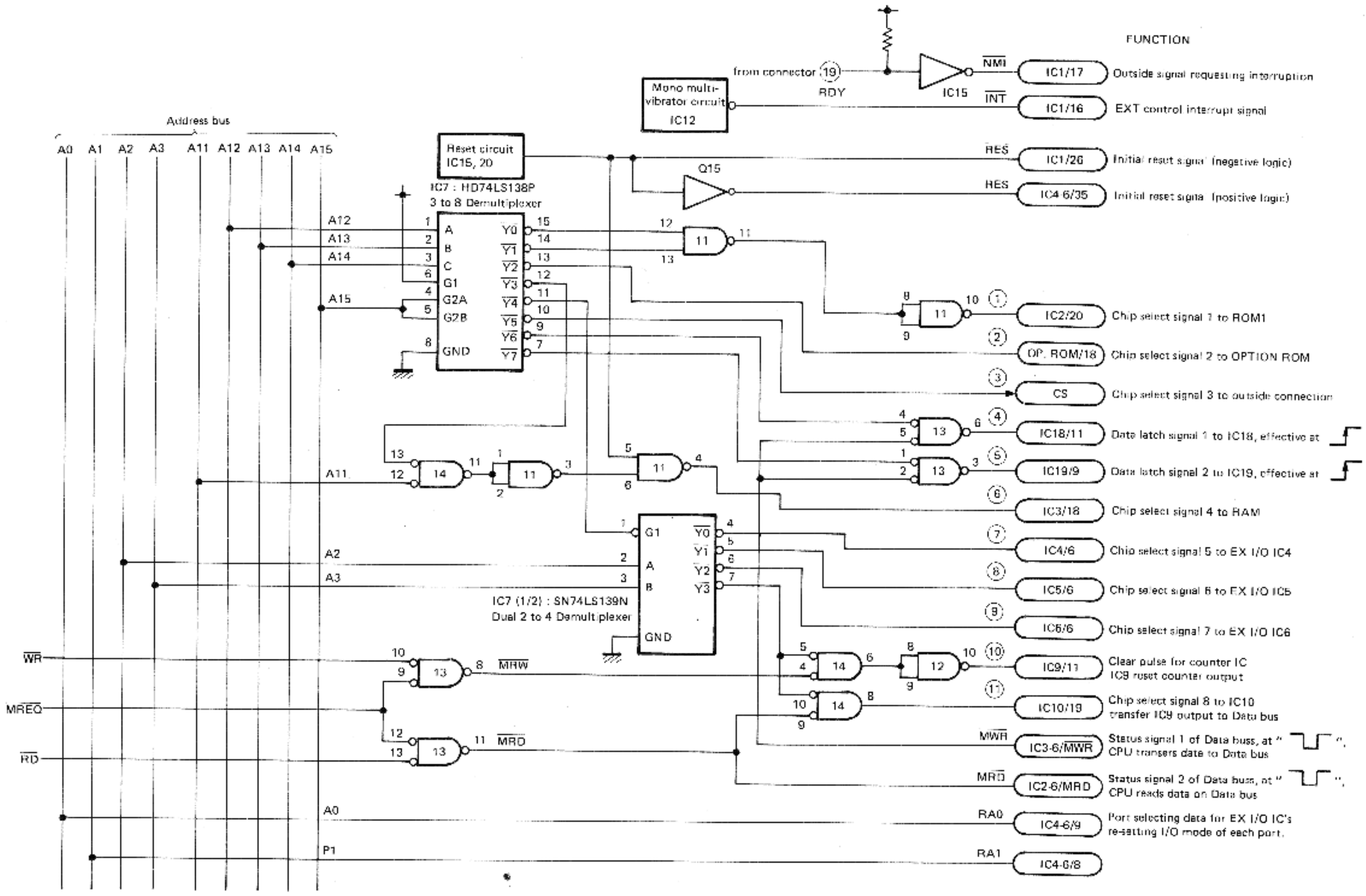
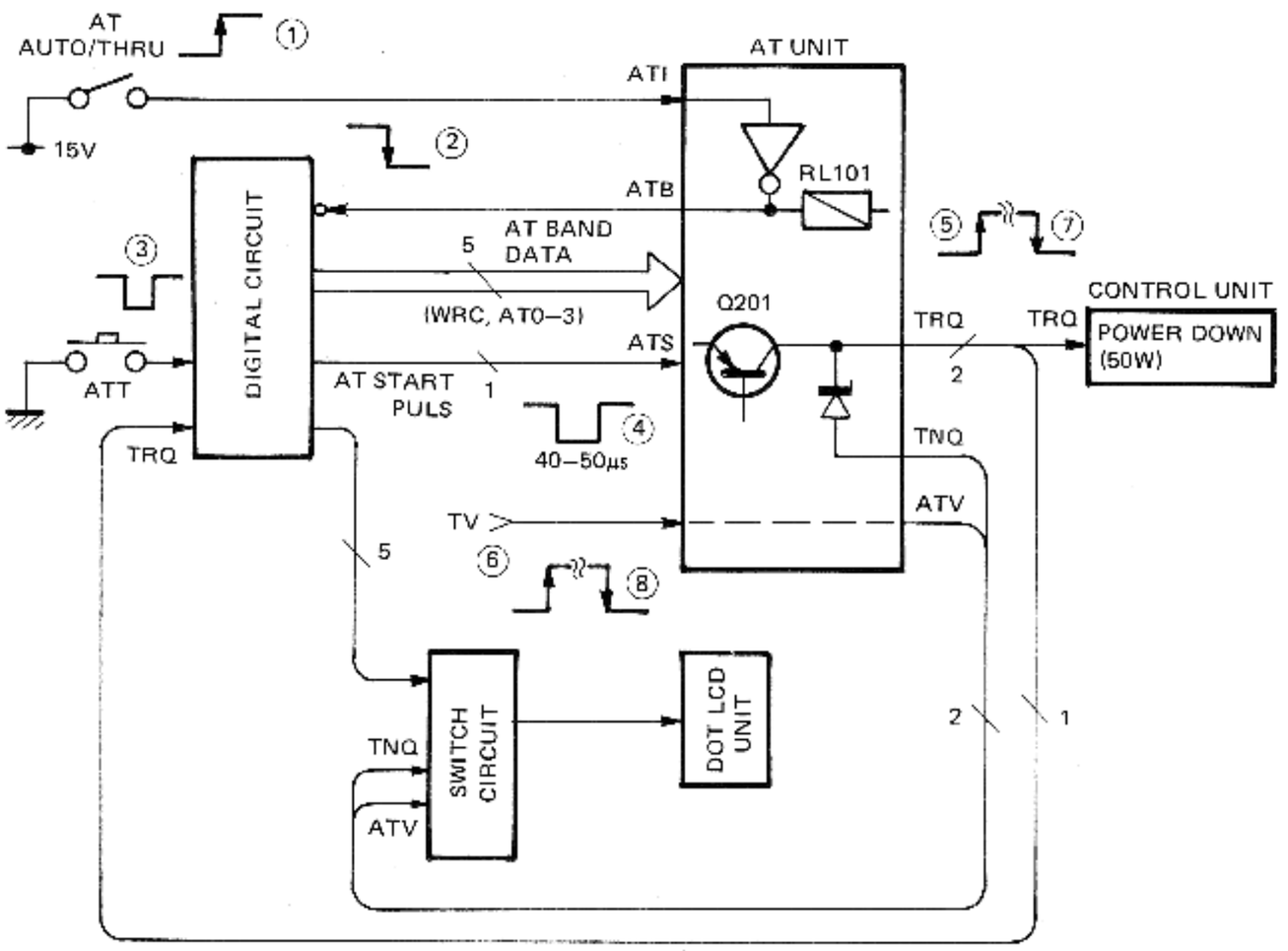



**Fig. 34 Digital-A unit control rogic diagram**




① AT switch → AUTO
② ATB output → LOW
AT UNIT RL101 → ON
③ ATT switch → 1 push
④ AT start signal out
⑤ TRQ } (AT STBY signal)
TNQ } → Hi level
- LCD DISPLAY
  "ANTENNA TUNER"
  "AUTO TUNE READY"
- TUNE LED → Light ON
- MODE LED → Light OFF
- POWER → 50W

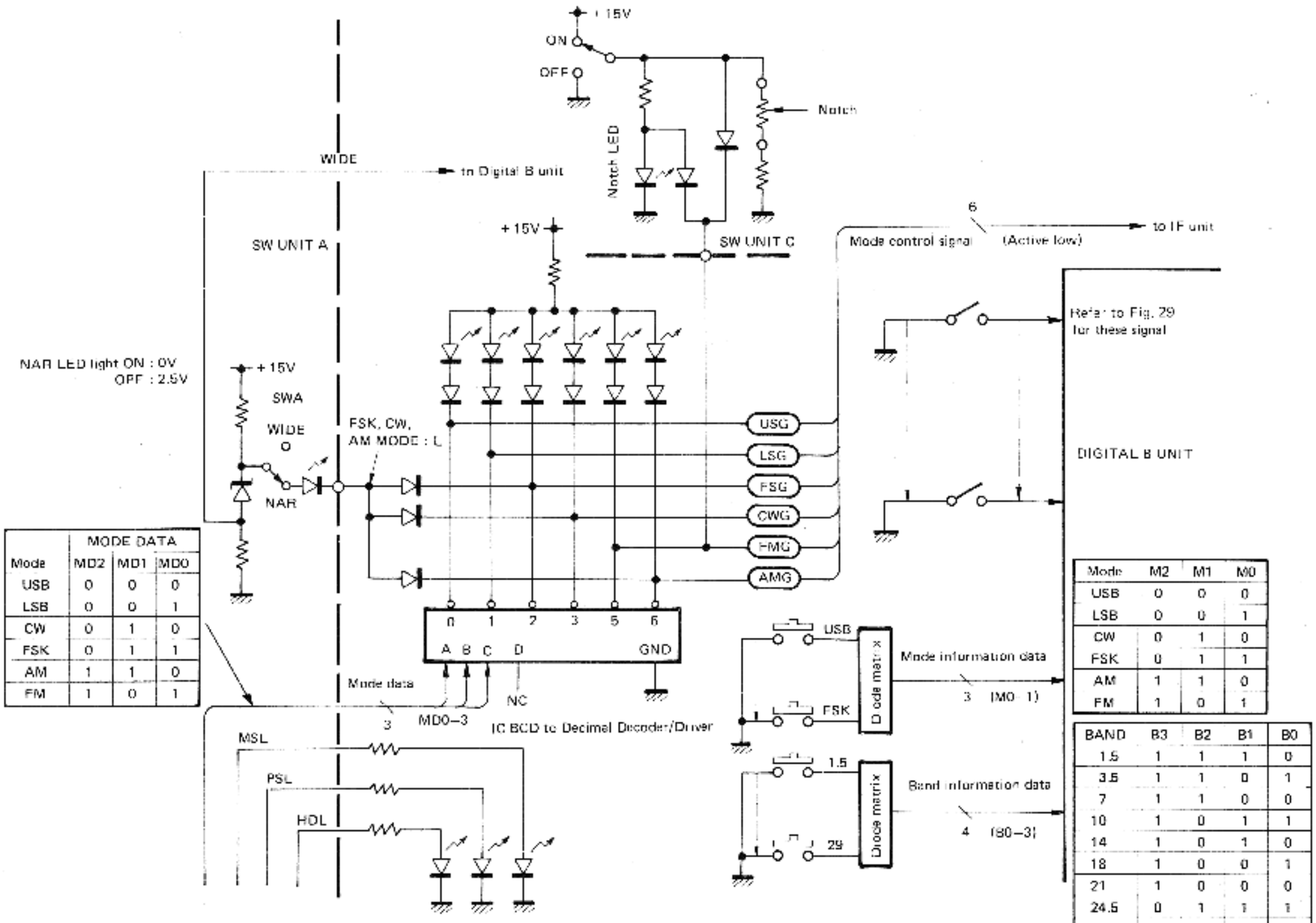
⑥ STBY SW →SEND
- TV → Hi level
- LCD DISPLAY
  "ANTENNA TUNER TUNING ---!!"
- TUNING
- TUN OK

⑦ TRQ } → Low level
TNQ }
- LCD DISPLAY
  "ANTENNA TUNING FINISHED
  TX READY"
- MODE LED → Light ON
- TUNE LED → Light OFF
- POWER → 100W

⑧ STBY SW → REC

**Fig. 35 Power control and AT unit**

# CIRCUIT DESCRIPTION




| | MODE DATA | | |
|---|---|---|---|
| Mode | MD2 | MD1 | MD0 |
| USB | 0 | 0 | 0 |
| LSB | 0 | 0 | 1 |
| CW | 0 | 1 | 0 |
| FSK | 0 | 1 | 1 |
| AM | 1 | 1 | 0 |
| FM | 1 | 0 | 1 |

| Mode | M2 | M1 | M0 |
|---|---|---|---|
| USB | 0 | 0 | 0 |
| LSB | 0 | 0 | 1 |
| CW | 0 | 1 | 0 |
| FSK | 0 | 1 | 1 |
| AM | 1 | 1 | 0 |
| FM | 1 | 0 | 1 |

| BAND | B3 | B2 | B1 | B0 |
|---|---|---|---|---|
| 1.5 | 1 | 1 | 1 | 0 |
| 3.5 | 1 | 1 | 0 | 1 |
| 7 | 1 | 1 | 0 | 0 |
| 10 | 1 | 0 | 1 | 1 |
| 14 | 1 | 0 | 1 | 0 |
| 18 | 1 | 0 | 0 | 1 |
| 21 | 1 | 0 | 0 | 0 |
| 24.5 | 0 | 1 | 1 | 1 |
| 28 | 0 | 1 | 1 | 0 |
| 29 | 0 | 1 | 0 | 1 |

**Fig. 36 Keyboard ass'y**

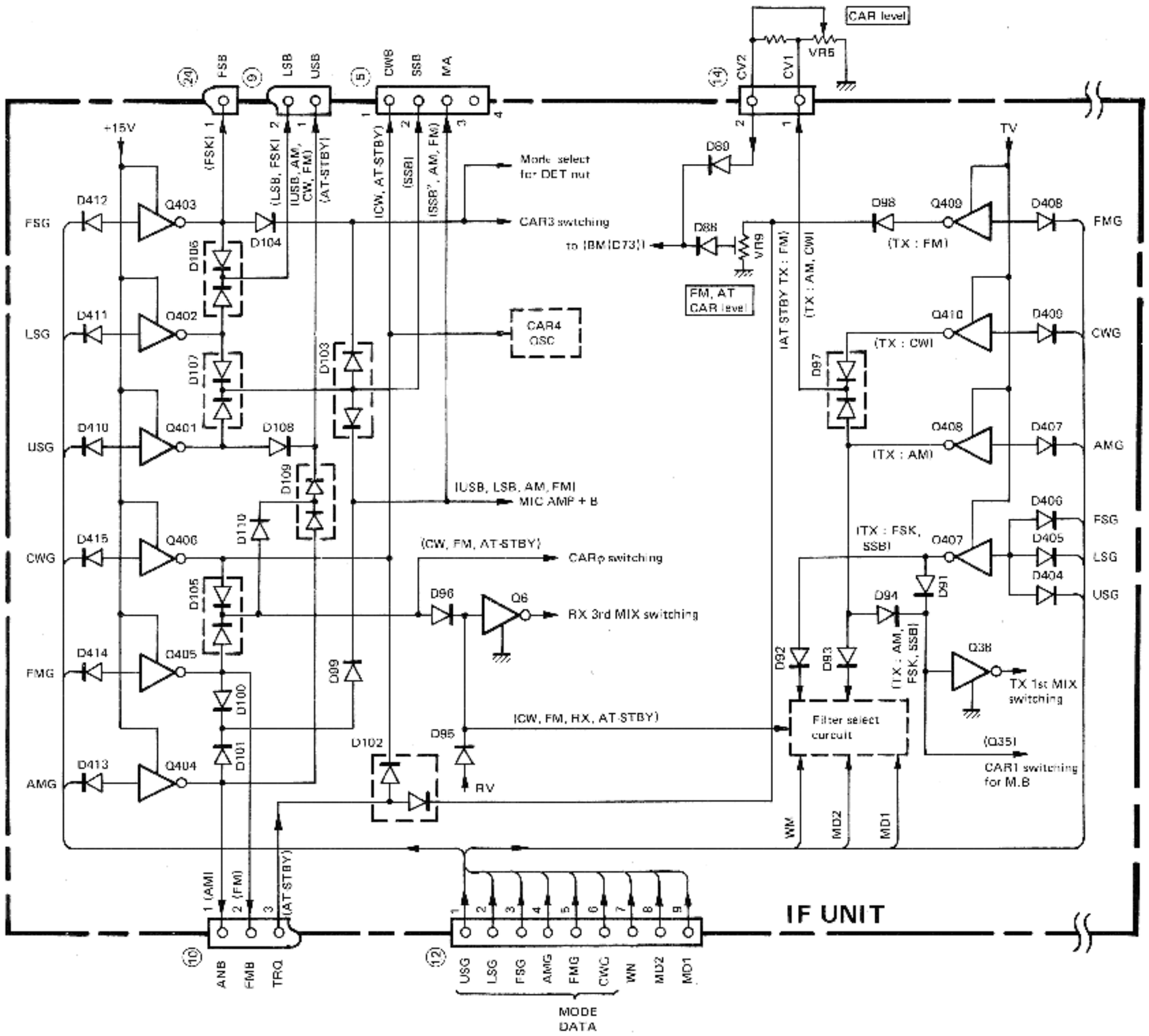



**Fig. 37 Mode selector signal block diagram**

# CIRCUIT DESCRIPTION

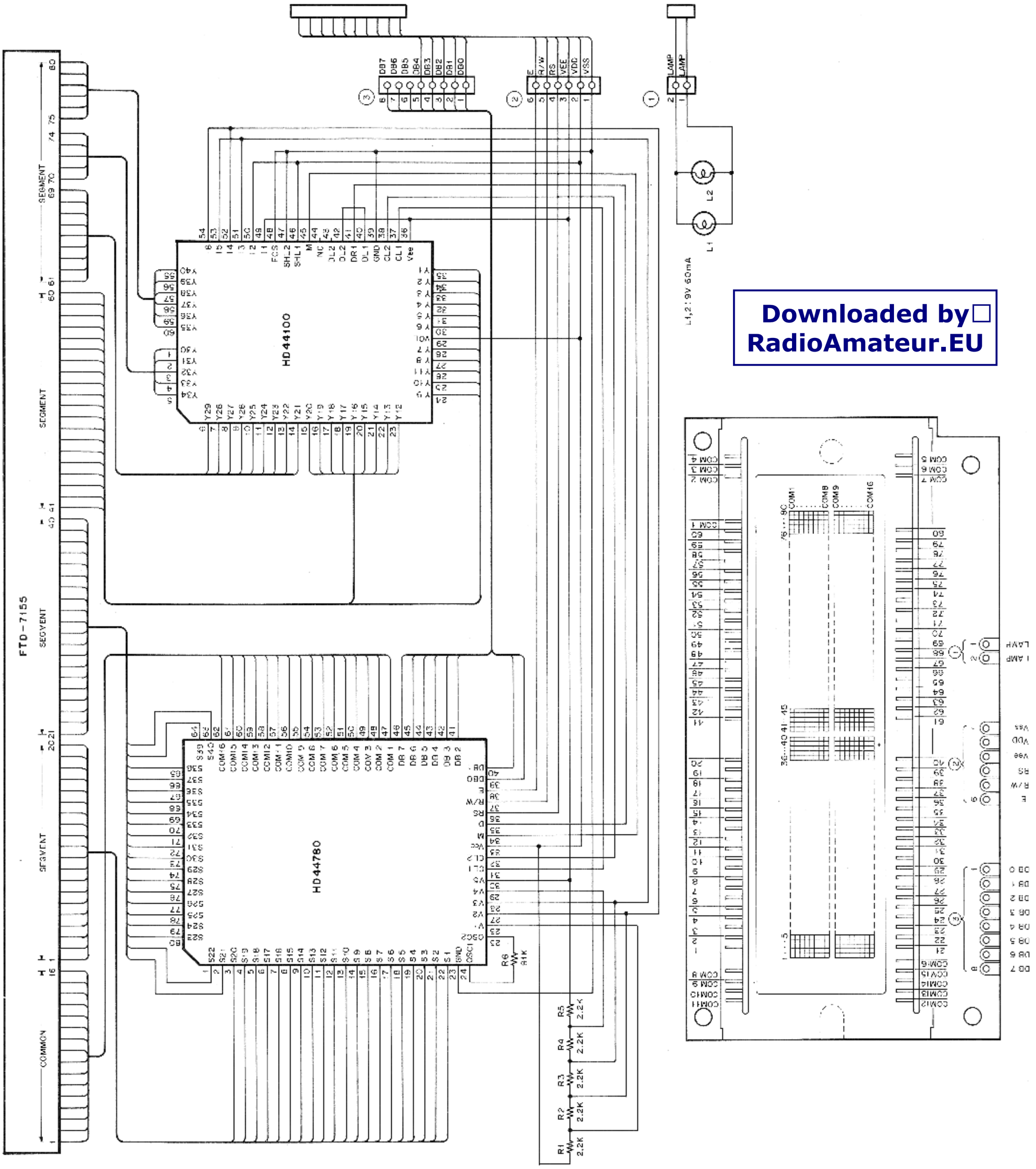
——: BPF cover range

| f (MHz) | N3 | ND | NA | VCO | | RX BPF | | | | LPF | | | WRC | AT. BAND | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | VC | | RB | | | | LP | | | | AT | | | | |
| | | | | 1 | 0 | 3 | 2 | 1 | 0 | 2 | 1 | 0 | | 3 | 2 | 1 | 0 |
| 0.0– 0.5 | 77 | 25 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 0.5– 1.0 | 76 | 25 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 1.0– 1.5 | 75 | 25 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1.5– 2.0 | 74 | 24 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 2.0– 2.5 | 73 | 24 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 2.5– 3.0 | 72 | 24 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 3.0– 3.5 | 71 | 23 | 2 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 3.5– 4.0 | 70 | 23 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 4.0– 4.5 | 69 | 23 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 4.5– 5.0 | 68 | 22 | 2 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 5.0– 5.5 | 67 | 22 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 5.5– 6.0 | 66 | 22 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 6.0– 6.5 | 65 | 21 | 2 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 6.5– 7.0 | 64 | 21 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 7.0– 7.5 | 63 | 21 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 7.5– 8.0 | 62 | 20 | 2 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 8.0– 8.5 | 61 | 20 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 8.5– 9.0 | 60 | 20 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 9.0– 9.5 | 59 | 19 | 2 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 9.5–10.0 | 58 | 19 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 10.0–10.5 | 57 | 19 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| 10.5–11.0 | 56 | 18 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 11.0–11.5 | 55 | 18 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 11.5–12.0 | 54 | 18 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 12.0–12.5 | 53 | 17 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 12.5–13.0 | 52 | 17 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 13.0–13.5 | 51 | 17 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 13.5–14.0 | 50 | 16 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 14.0–14.5 | 49 | 16 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 14.5–15.0 | 48 | 16 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 15.0–15.5 | 47 | 15 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 15.5–16.0 | 46 | 15 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 16.0–16.5 | 45 | 15 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 16.5–17.0 | 44 | 14 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 17.0–17.5 | 43 | 14 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 17.5–18.0 | 42 | 14 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 18.0–18.5 | 41 | 13 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 18.5–19.0 | 40 | 13 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 19.0–19.5 | 39 | 13 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 19.5–20.0 | 38 | 12 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 20.0–20.5 | 37 | 12 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 20.5–21.0 | 36 | 12 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 21.0–21.5 | 35 | 11 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 21.5–22.0 | 34 | 11 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 22.0–22.5 | 33 | 11 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 22.5–23.0 | 32 | 10 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 23.0–23.5 | 31 | 10 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 23.5–24.0 | 30 | 10 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 24.0–24.5 | 29 | 9 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 24.5–25.0 | 28 | 9 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 25.0–25.5 | 27 | 9 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 25.5–26.0 | 26 | 8 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 26.0–26.5 | 25 | 8 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 26.5–27.0 | 24 | 8 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 27.0–27.5 | 23 | 7 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 27.5–28.0 | 22 | 7 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 28.0–29.5 | 21 | 7 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 28.5–29.0 | 20 | 6 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 29.0–29.5 | 19 | 6 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 29.5–30.0 | 18 | 6 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 30.0–30.5 | 17 | 5 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |

*N3 = 3ND + NA

**Table 20 Frequency control data**

# SEMICONDUCTOR DATA

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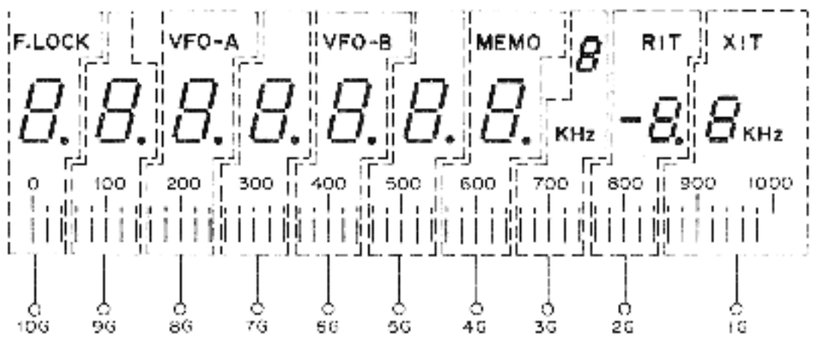
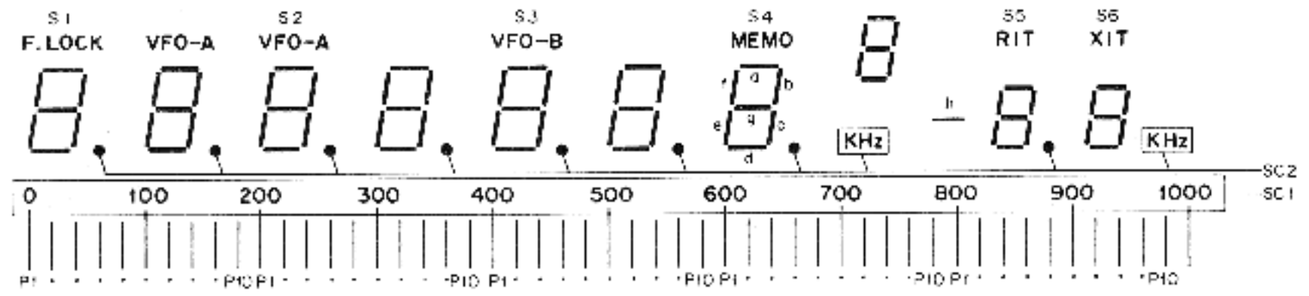
RadioAmateur.EU

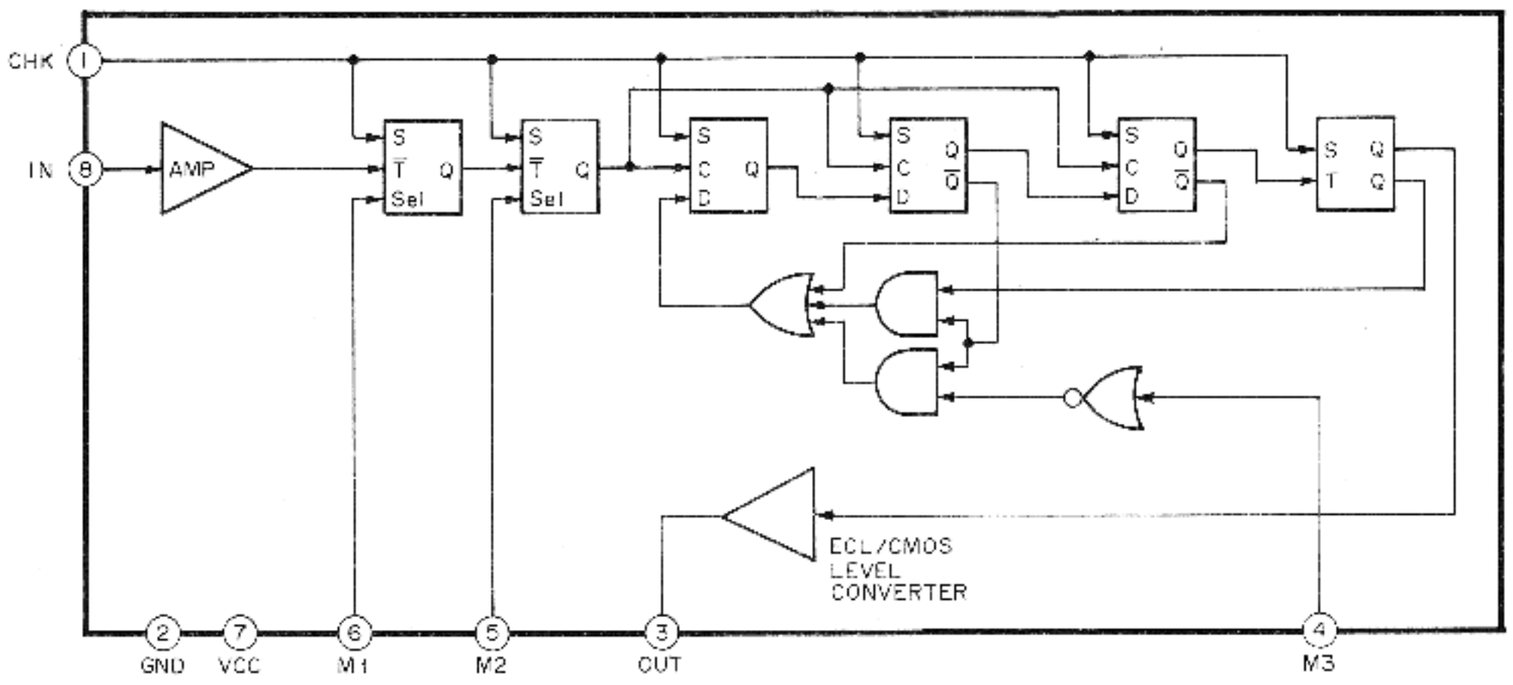
FTD-7155 (LCD unit V1)

# SEMICONDUCTOR DATA

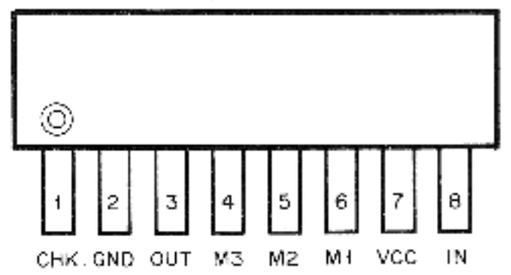



**11-BT-05Z (SW unit-M V1)**




**HD10551 Block diagram (PLL unit IC5, 11)**

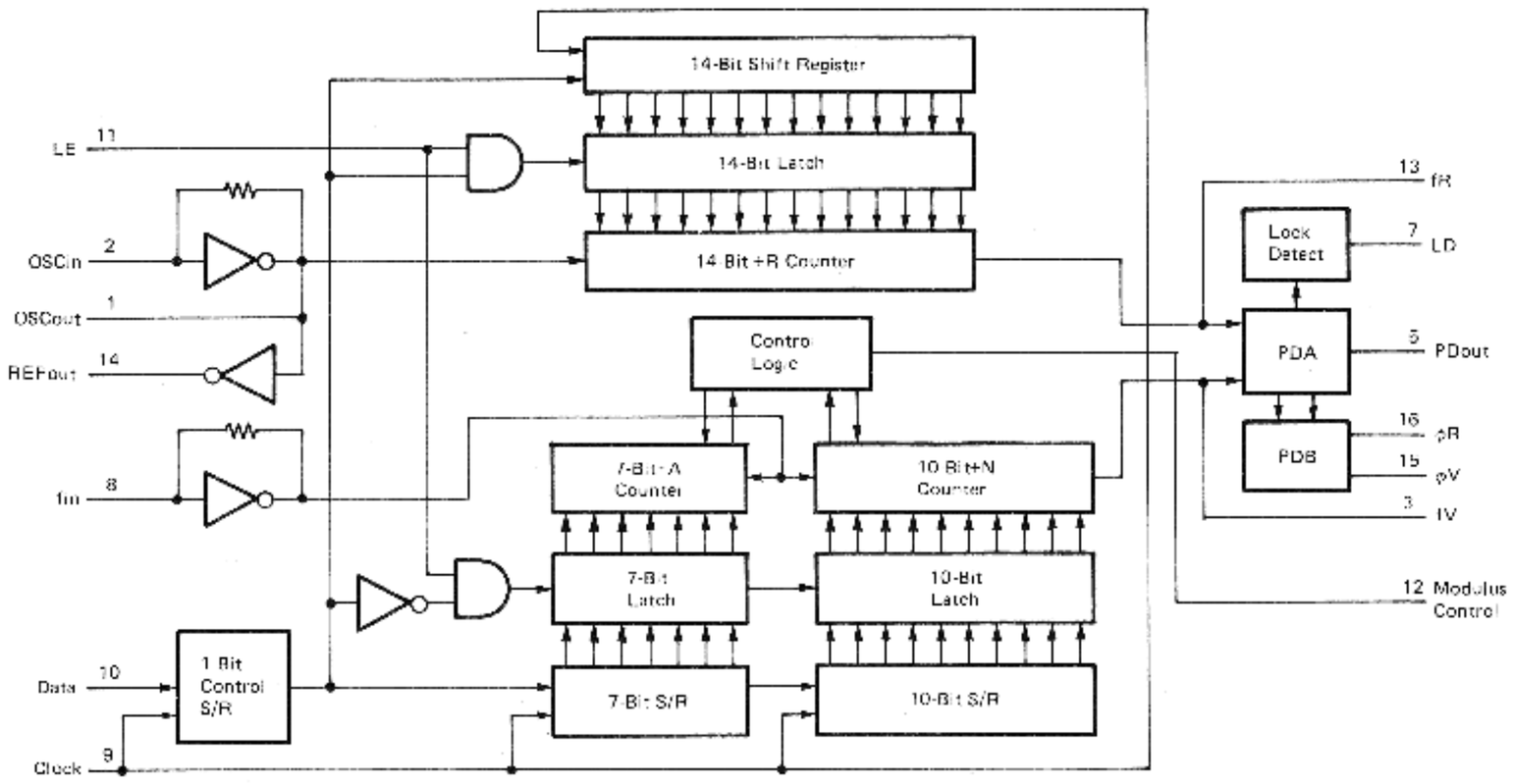



**HD10551 Terminal**

| Symbol | Value | Unit |
|---|---|---|
| Vcc | 8 | V |
| Vin | 8 | V |
| PT | 350 (at 75°C) | mW |
| Topr | −30~ + 75 | °C |
| Tstg | −55~ + 125 | °C |

**HD10551 Max. rating**

| Divid | CHK 1 pin | M1 6 pin | M2 5 pin | M3 4 pin |
|---|---|---|---|---|
| 1/10 | GND | Vcc | Vcc | GND |
| 1/11 | GND | Vcc | Vcc | Vcc |
| 1/20 | GND | GND | Vcc | GND |
| 1/22 | GND | GND | Vcc | Vcc |
| 1/40 | GND | GND | GND | GND |
| 1/44 | GND | GND | GND | Vcc |

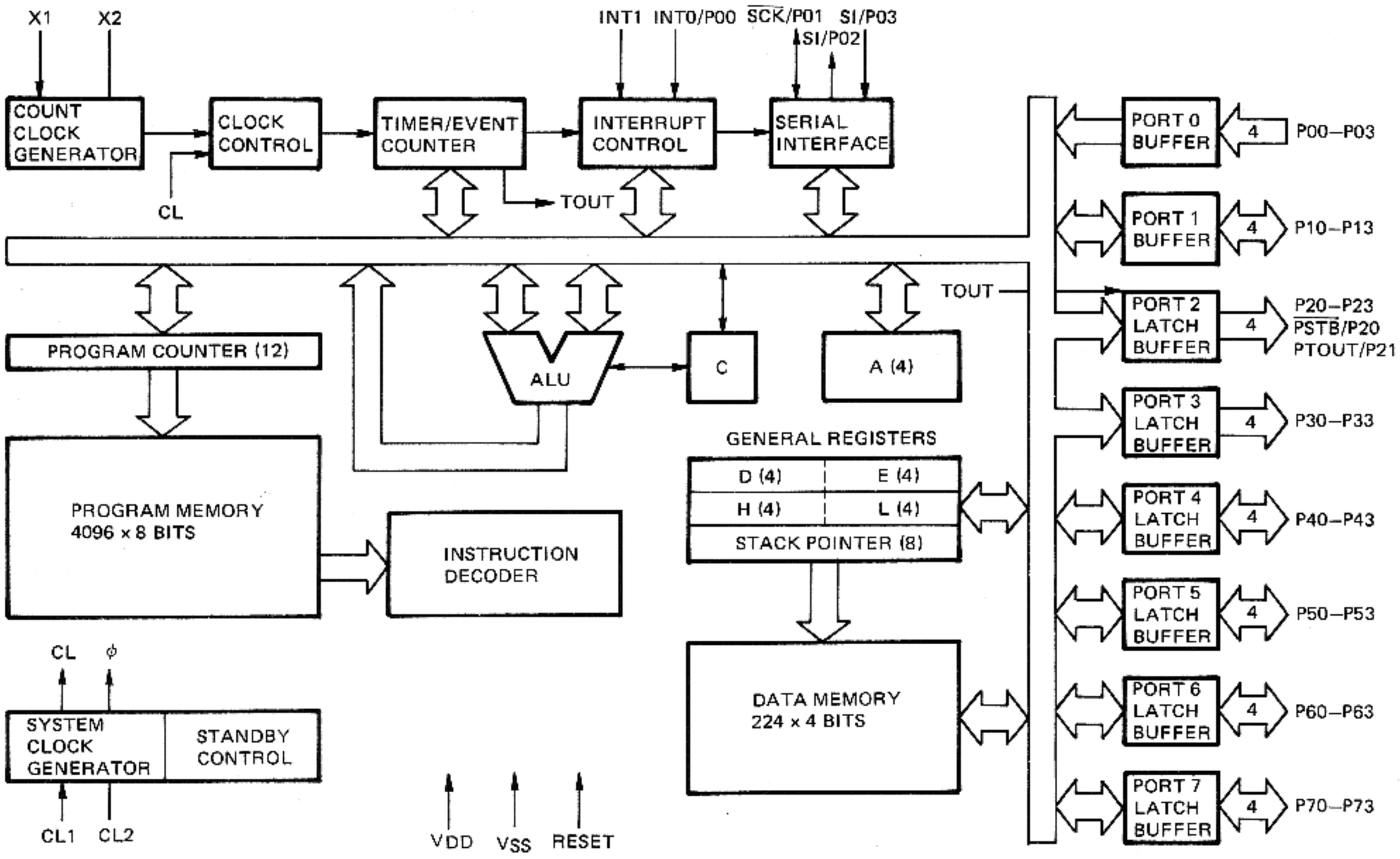



**MC145158P Block diagram (PLL unit IC17)**

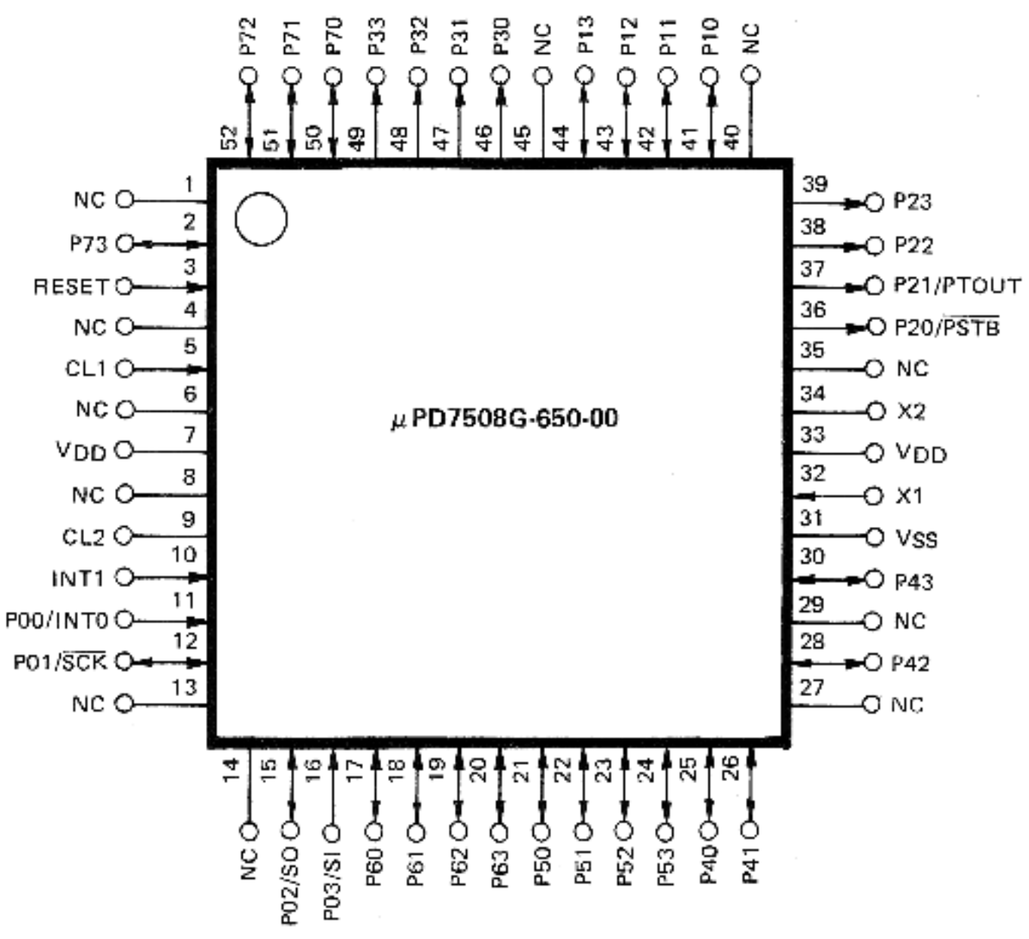
| Symbol | Value | Unit |
|---|---|---|
| VDD | −0.5 to + 10 | V |
| Vin | −0.5 to VDD + 0.5 | V |
| I | 10 | mA |
| I | 30 | mA |
| TA | −40 to + 85 | °C |
| Tstg | −65 to + 150 | °C |

**MC145158P Max. rating**

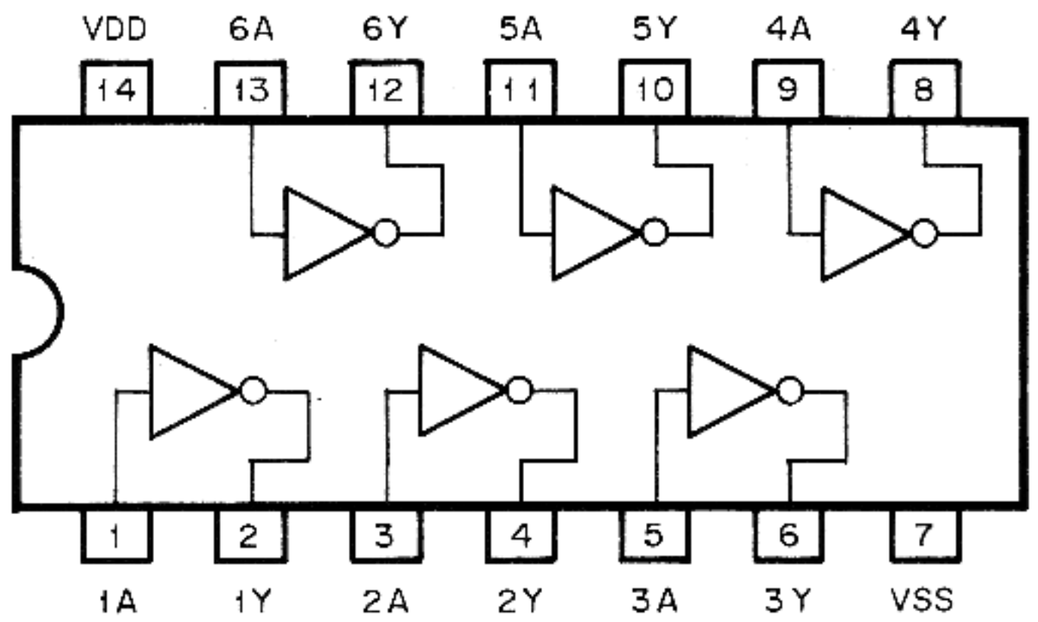
# SEMICONDUCTOR DATA




**μPD7508G-650-00 Block diagram (SW unit (L) IC1)**




**μPD7508G-650-00 (Top view)**

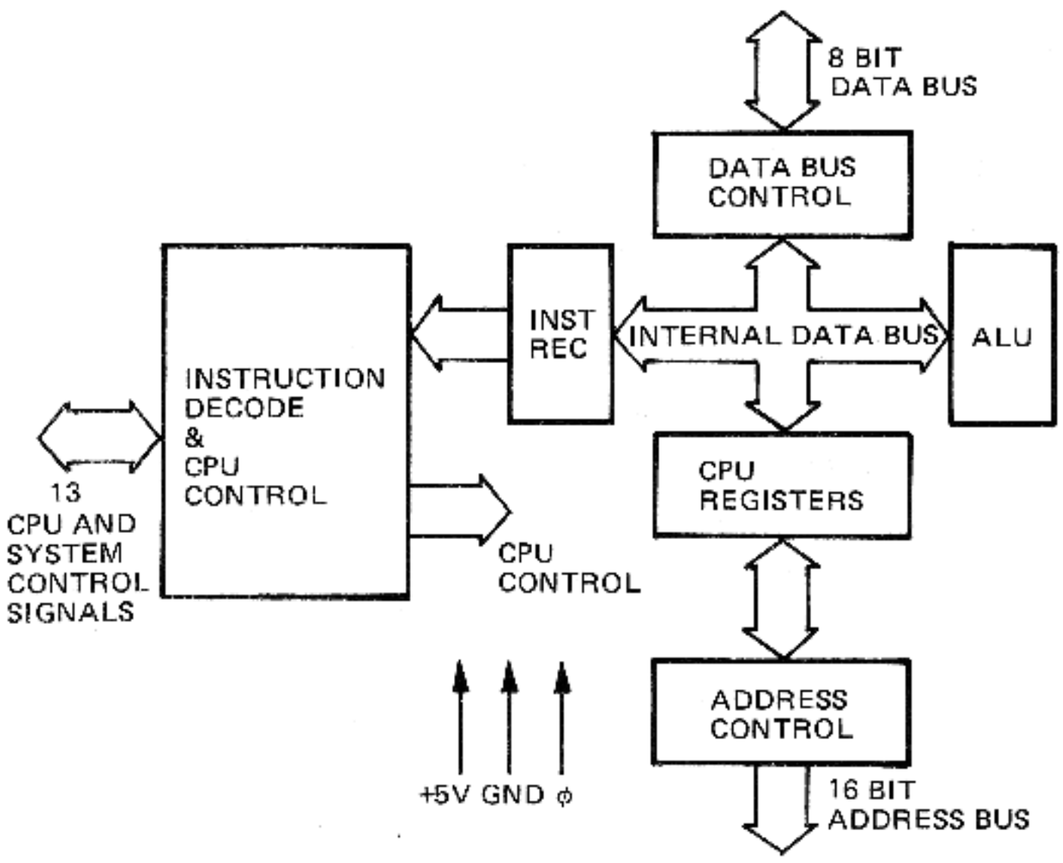



**TC40H004P (DG-A unit IC15)**

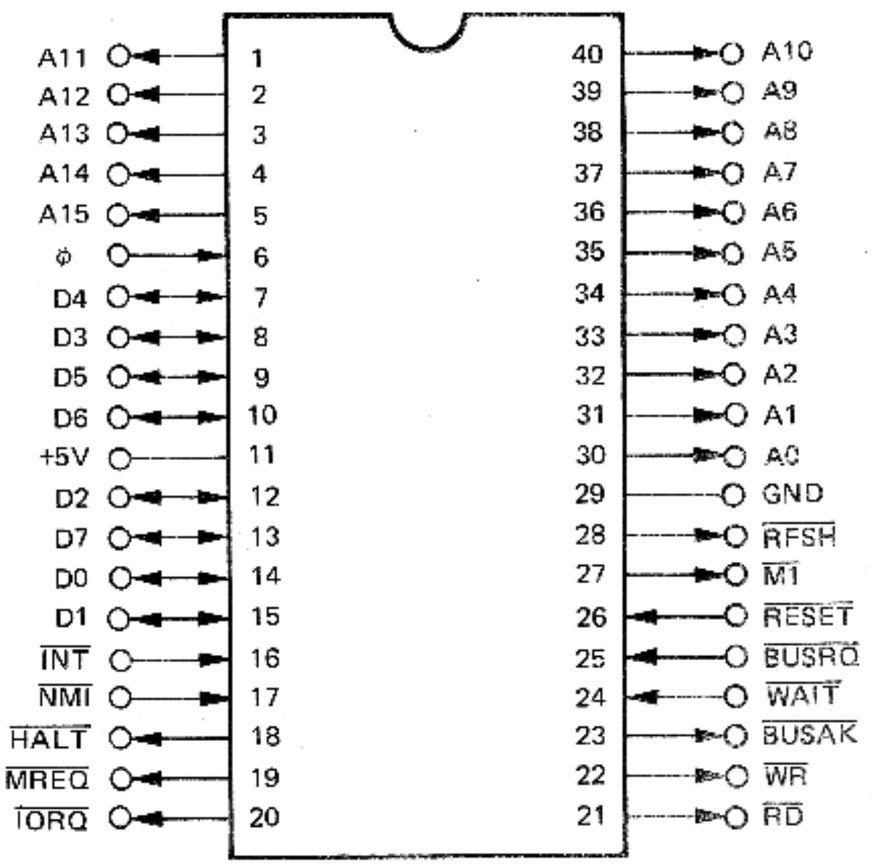
| Symbol | Rating | Unit |
|---|---|---|
| $V_{DD}$ | Vss–0.5~Vss + 10 | V |
| $V_{IN}$ | Vss–0.5~$V_{DD}$ + 0.5 | V |
| $V_{OUT}$ | Vss–0.5~$V_{DD}$ + 0.5 | V |
| $I_{IN}$ | ±10 | mA |
| $P_D$ | 300 (DIP)/180 (MFP) | mW |
| Totg | –65~150 | °C |
| Tsol | 260°C · 10sec | |

**TC40H004P Max. rating**

# SEMICONDUCTOR DATA




LH-0080A Block diagram (DG-A unit IC1)




LH-0080A (Top view)

MAIN REG SET / ALTERNATE REG SET

| ACCUMULATOR | FLAGS | ACCUMULATOR | FLAGS |
|---|---|---|---|
| A | F | A | F′ |
| B | C | B | C′ |
| D | E | D′ | E |
| H | L | H′ | L′ |

GENERAL PURPOSE REGISTERS

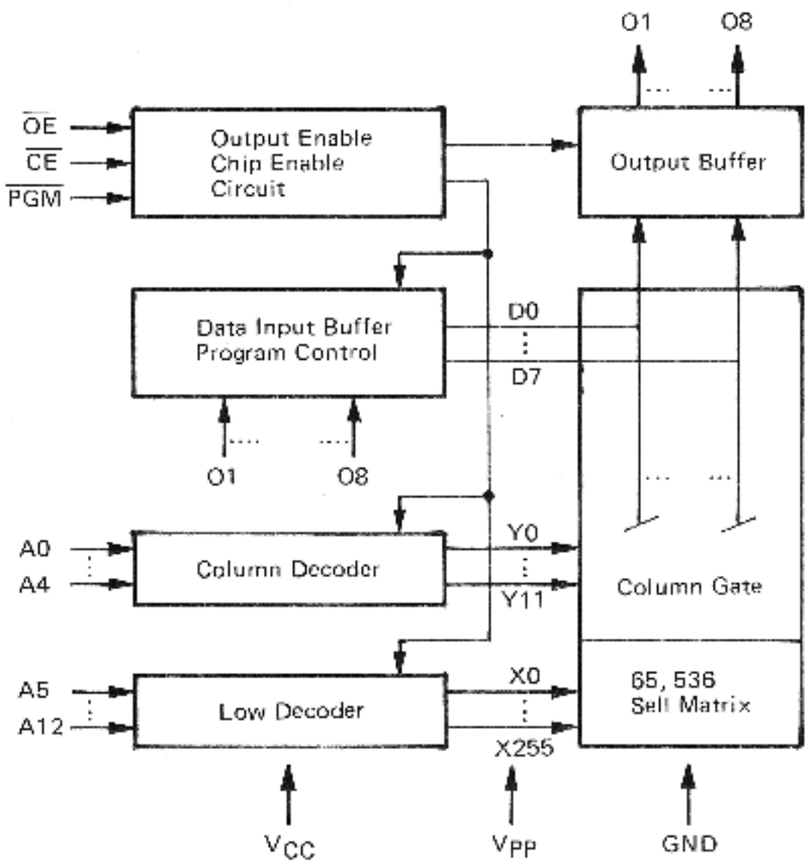
| | |
|---|---|
| INTERRUPT VECTOR I | MEMORY REFRESH R |
| INDEX REGISTER IX | |
| INDEX REGISTER IV | |
| STACK POINTER SP | |
| PROGRAM COUNTER PC | |

SPECIAL PURPOSE REGISTERS

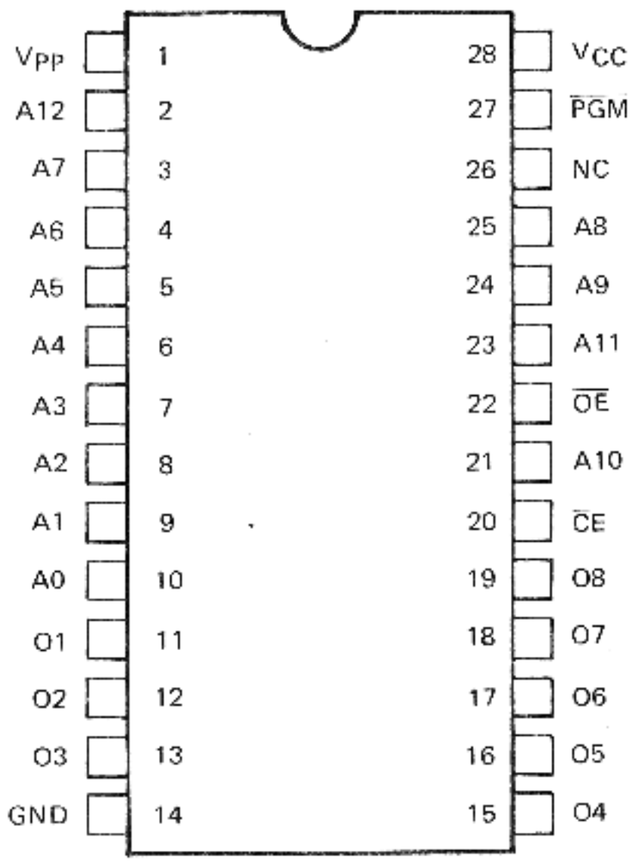
| Terminal No. | Terminal Name | Terminal Function |
|---|---|---|
| 1 | A11 | Address bus |
| 2 | A12 | |
| 3 | A13 | |
| 4 | A14 | |
| 5 | A15 | |
| 6 | φ | Clock input approx. 2.5MHz |
| 7 | D4 | Data bus |
| 8 | D3 | |
| 9 | D5 | |
| 10 | D6 | |
| 11 | + 5V | Power supply |
| 12 | D2 | Data bus |
| 13 | D7 | |
| 14 | D0 | |
| 15 | D1 | |
| 16 | $\overline{INT}$ | Interrupt input |
| 17 | $\overline{MNI}$ | External control interrupt input |
| 18 | $\overline{HALT}$ | Not used. |
| 19 | $\overline{MREQ}$ | External access. signal output |
| 20 | $\overline{IORQ}$ | Not used. |
| 21 | RD | Read strobe output |
| 22 | WR | Write strobe output |
| 23 | $\overline{BUSAK}$ | Not used |
| 24 | $\overline{WAIT}$ | Not used. |
| 25 | $\overline{BUSRQ}$ | Not used. |
| 26 | $\overline{RESET}$ | Reset input (active : L) |
| 27 | $\overline{M1}$ | Not used. |
| 28 | $\overline{RFSH}$ | Not used. |
| 29 | GND | GND |
| 30 | A0 | Address bus |
| 31 | A1 | |
| 32 | A2 | |
| 33 | A3 | |
| 34 | A4 | |
| 35 | A5 | |
| 36 | A6 | |
| 37 | A7 | |
| 38 | A8 | |
| 39 | A9 | |
| 40 | A10 | |

LH-0080A Terminal function

# SEMICONDUCTOR DATA



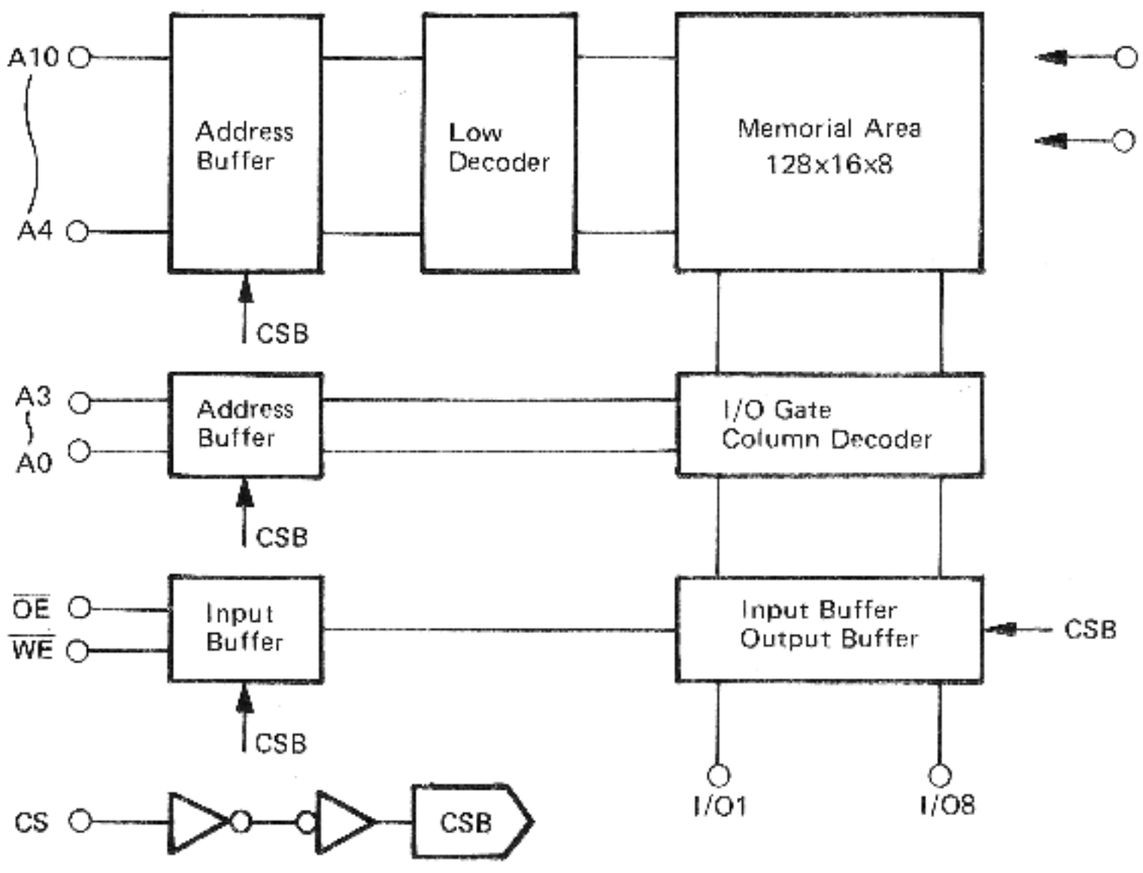

**MBM2764-30 Block diagram (DG-A unit IC2)**



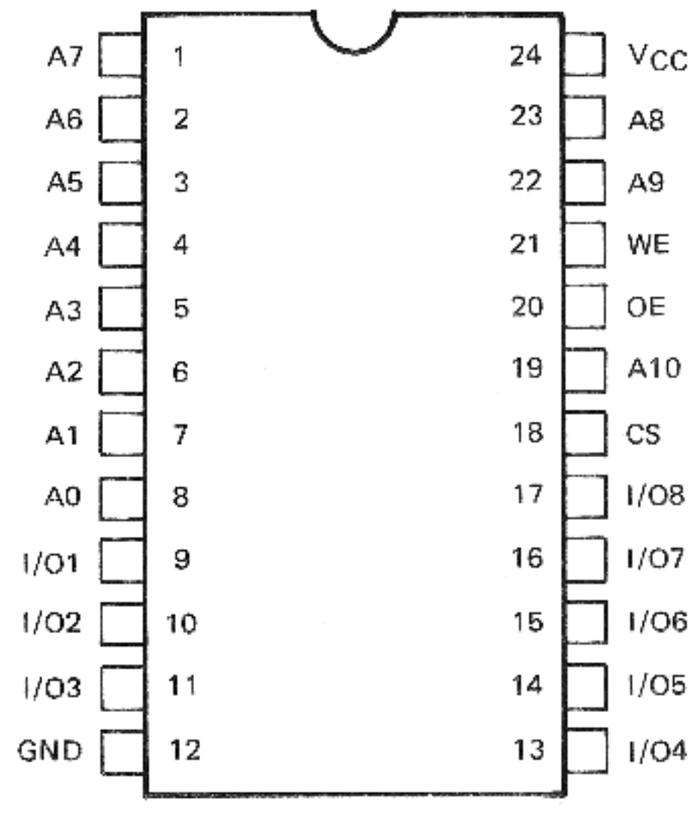

**MBM2764-30 (Top view)**

| Symbol | Terminal Name | Symbol | Terminal Name |
|---|---|---|---|
| A0—A12 | Address input | Vpp | Program power supply |
| O1—O8 | Data output (input) | Vcc | Power supply (+ 5V) |
| $\overline{CE}$ | Chip enable | GND | Ground |
| $\overline{OE}$ | Output enable | NC | No connection |
| $\overline{PGM}$ | Program input·output enable | | |

**MBM2764-30 Terminal name**




**MB8416-20LP-GRA Block diagram (DG-A unit IC3)**

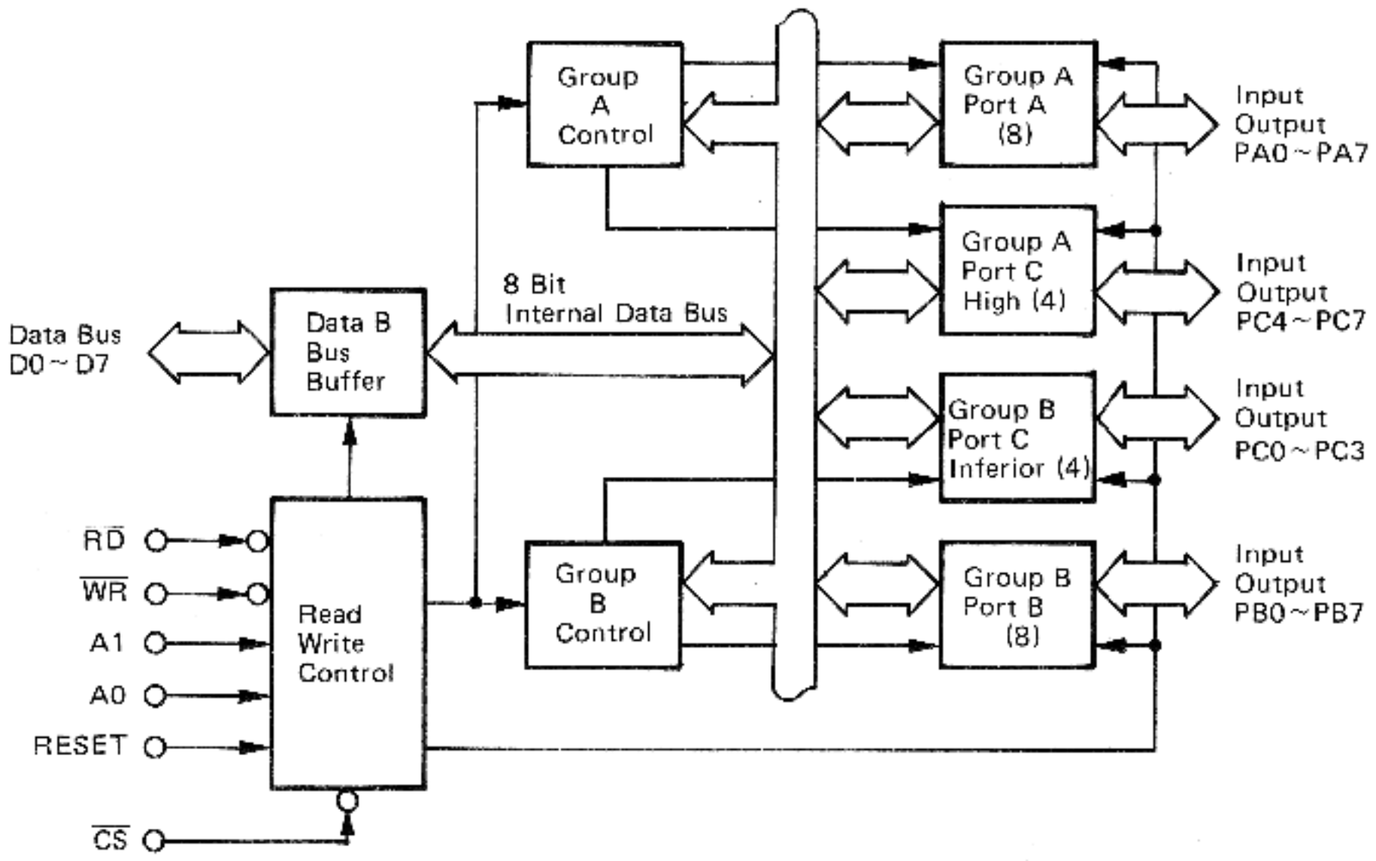



**MB8416-20LP-GRA (Top view)**

| Symbol | Terminal Functions | Symbol | Terminal Functions |
|---|---|---|---|
| A0—A10 | Address input | WE | Write enable |
| I/01—I/08 | Data input, output | Vcc | Power supply (+5V) |
| CS | Chip select | GND | Ground |
| OE | Output enable | NC | Not connected. |

**MB8416-20LP-GRA Terminal name**

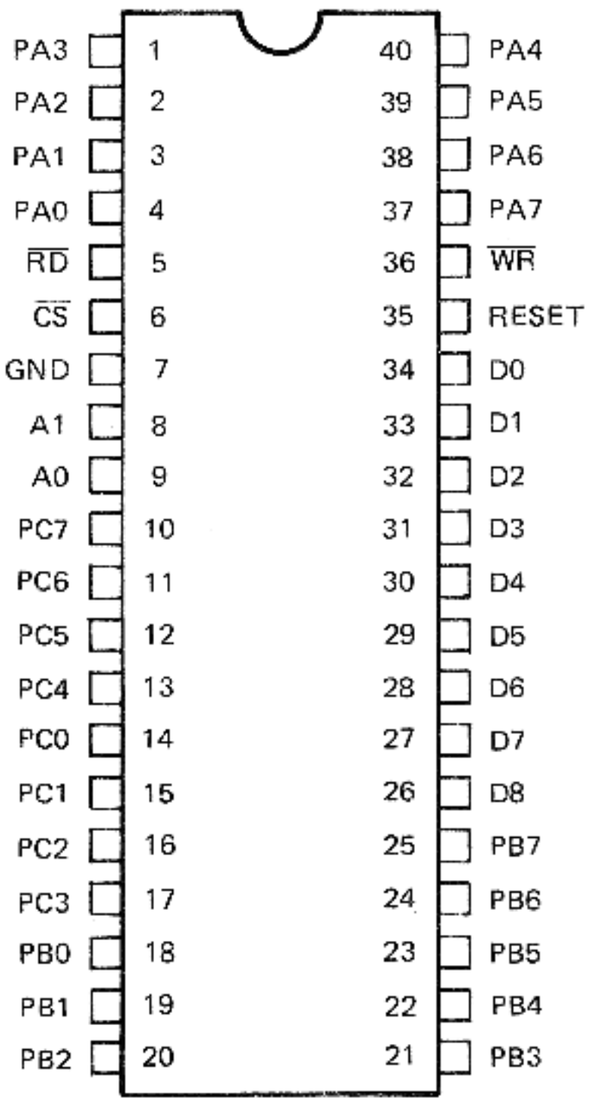
# SEMICONDUCTOR DATA




Terminal name

| | | | |
|---|---|---|---|
| D0—D7 : | Data bus (each direction) | A0,A1 : | Port address |
| CS : | Chip select | PA0—PA7 : | Port A input, output |
| RESET : | Reset | PB0—PB7 : | Port B input, output |
| RD : | Read control | PC0—PC7 : | Port C input, output |
| WR : | Write control | | |

**μPD8255AC-5 Block diagram (DG-A unit IC4—6)**




**μPD8255AC-5 (Top view)**

| Terminal No. | Terminal Name | Terminal Function | Terminal No. | Terminal Name | Terminal Function |
|---|---|---|---|---|---|
| 1 | PA3 | Display tube grid drive signal G4 | 21 | PB3 | Segment data b/VFO A/P2 |
| 2 | PA2 | Display tube grid drive signal G3 | 22 | PB4 | Segment data c/VFO B/P3 |
| 3 | PA1 | Display tube grid drive signal G2 | 23 | PB5 | Segment data d/RIT/P4 |
| 4 | PA0 | Display tube grid drive signal G1 | 24 | PB6 | Segment data e/XIT/P5 |
| 5 | RD | Read strobe input | 25 | PB7 | Segment data f/—/P6 |
| 6 | CS | Chip select input | 26 | Vcc | + 5V |
| 7 | GND | GND | 27 | D7 | Data bus |
| 8 | A1 | Address signal input | 28 | D6 | |
| 9 | A0 | Address signal input | 29 | D5 | |
| 10 | PC7 | Segment data control bit | 30 | D4 | |
| 11 | PC6 | | 31 | D3 | |
| 12 | PC5 | Display tube grid drive signal G10 | 32 | D2 | |
| 13 | PC4 | Display tube grid drive signal G9 | 33 | D1 | |
| 14 | PC0 | Analog data P7 | 34 | D0 | |
| 15 | PC1 | Analog data P8 | 35 | Reset | Reset input (Active : H) |
| 16 | PC1 | Analog data P9 | 36 | WR | Write strobe input |
| 17 | PC3 | Analog data P10 | 37 | PA7 | Display tube grid drive signal G8 |
| 18 | PB0 | Segment data dp | 38 | PA6 | Display tube grid drive signal G7 |
| 19 | PB1 | Segment data g | 39 | PA5 | Display tube grid drive signal G6 |
| 20 | PB2 | Segment data a/MEMO/P1 | 40 | PA4 | Display tube grid drive signal G5 |

**Note)** Each data of pins 20—26 is choosen by the three types data of pins 10,11.

**Terminal function (IC4)**

# SEMICONDUCTOR DATA

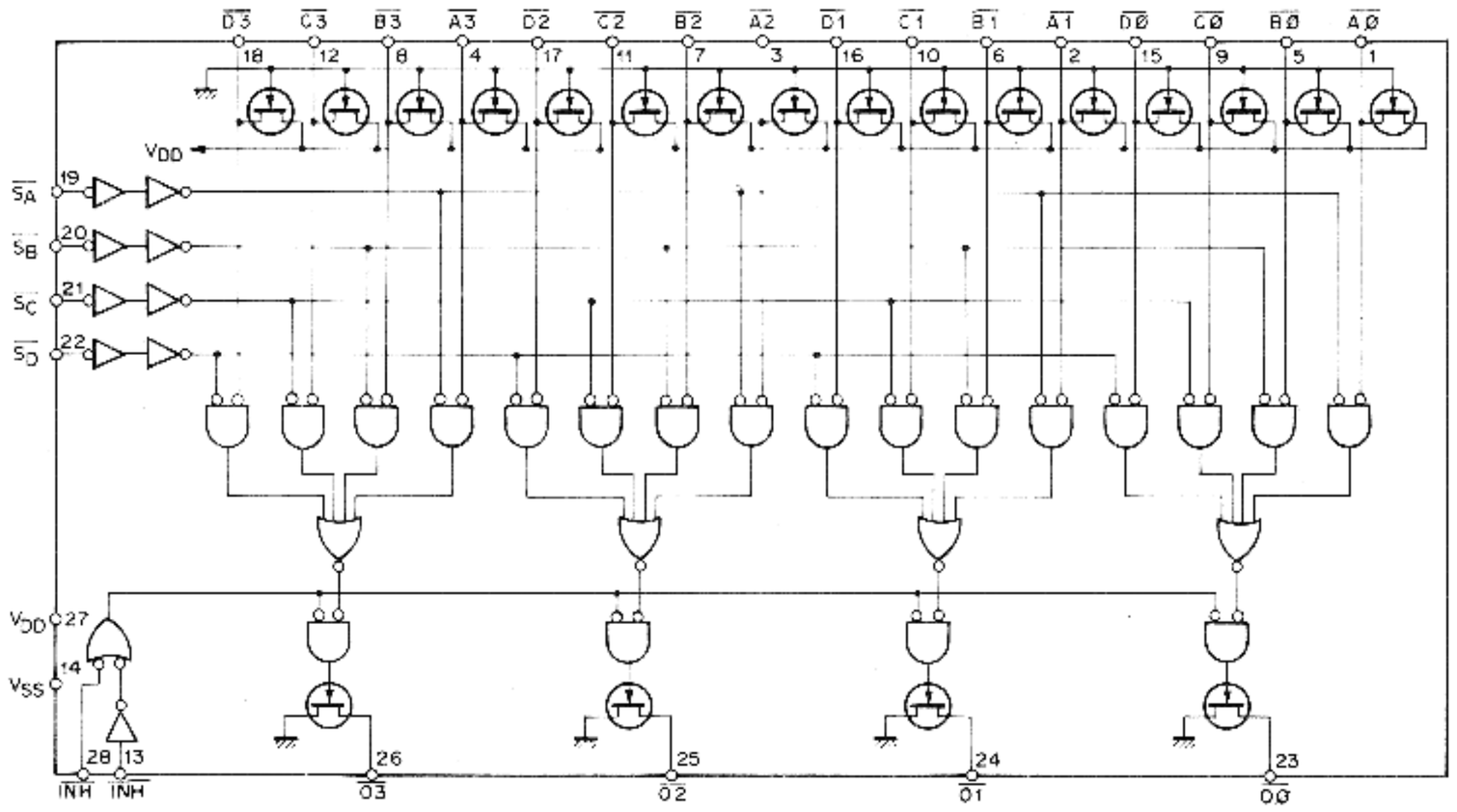
| Terminal No. | Terminal Name | Terminal Function | Terminal No. | Terminal Name | Terminal Function |
|---|---|---|---|---|---|
| 1 | PA3 | AT3 | 21 | PB3 | DA3 PLL data for MN6147 bit 3 |
| 2 | PA2 | AT2 } AT band data | 22 | PB4 | CL0 HET 36M PLL clock |
| 3 | PA1 | AT1 } AT band data | 23 | PB5 | CL1 Main loop 10Hz PLL clock |
| 4 | PA0 | AT0 } AT band data | 24 | PB6 | CL2 Main loop 10kHz |
| 5 | RD | Read strobe input | 25 | PB7 | CL3 Main loop 500k |
| 6 | CS | Chip select input | 26 | Vcc | + 5V |
| 7 | GND | GND | 27 | D7 | } Data bus |
| 8 | A1 | Address signal input | 28 | D6 | } Data bus |
| 9 | A0 | Address signal input | 29 | D5 | } Data bus |
| 10 | PC7 | PLD Main loop 500k PLL data | 30 | D4 | } Data bus |
| 11 | PC6 | PLE Main loop 500k PLL latch enable | 31 | D3 | } Data bus |
| 12 | PC5 | CL5 CAR PLL clock for 71.5MHz | 32 | D2 | } Data bus |
| 13 | PC4 | CL4 CAR PLL clock for 45.5MHz | 33 | D1 | } Data bus |
| 14 | PC0 | VBT Cord SW select output | 34 | D0 | } Data bus |
| 15 | PC1 | SPL Cord SW select output | 35 | Reset | Reset input (Active : H) |
| 16 | PC2 | SPH Cord SW select output | 36 | WR | Write strobe input |
| 17 | PC3 | BLK Blamking puse | 37 | PA7 | LP2 } LPF Band data |
| 18 | PB0 | DA0 } PLL data for MN6147 bit 0 | 38 | PA6 | LP1 } LPF Band data |
| 19 | PB1 | DA1 } PLL data for MN6147 bit 1 | 39 | PA5 | LP0 } LPF Band data |
| 20 | PB2 | DA2 } PLL data for MN6147 bit 2 | 40 | PA4 | WRC AT Band data |

**Terminal function (IC5)**

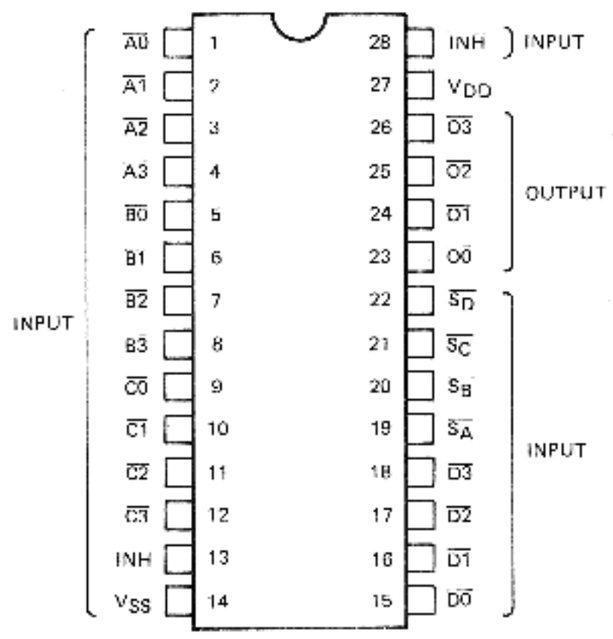
| Terminal No. | Terminal Name | Terminal Function | Terminal No. | Terminal Name | Terminal Function |
|---|---|---|---|---|---|
| 1 | PA3 | N/W, Narrow, wide output | 21 | PB3 | Lock indicator output |
| 2 | PA2 | ML2 | 22 | PB4 | SW select output A |
| 3 | PA1 | ML1 Mode LED output | 23 | PB5 | SW select output B |
| 4 | PA0 | ML0 | 24 | PB6 | SW control output |
| 5 | $\overline{RD}$ | Read strobe input | 25 | PB7 | RIT Clear pulse |
| 6 | $\overline{CS}$ | Chip select input | 26 | Vcc | + 5V |
| 7 | GND | GND | 27 | D7 | } Data bus |
| 8 | A1 | Address signal input | 28 | D6 | } Data bus |
| 9 | A0 | Address signal input | 29 | D5 | } Data bus |
| 10 | PC7 | } SW data input port | 30 | D4 | } Data bus |
| 11 | PC6 | } SW data input port | 31 | D5 | } Data bus |
| 12 | PC5 | } SW data input port | 32 | D2 | } Data bus |
| 13 | PC4 | } SW data input port | 33 | D1 | } Data bus |
| 14 | PC0 | } SW data input port | 34 | D0 | } Data bus |
| 15 | PC1 | } SW data input port | 35 | Reset | Reset input (Active : H) |
| 16 | PC2 | } SW data input port | 36 | $\overline{WR}$ | Write strobe input |
| 17 | PC3 | } SW data input port | 37 | PA7 | Buzzer pulse |
| 18 | PB0 | TX standby output | 38 | PA6 | Band data |
| 19 | PB1 | Split LED output | 39 | PA5 | VC1 } VCO select output |
| 20 | PB2 | AT start pulse output | 40 | PA4 | VC0 } VCO select output |

**Terminal function (IC6)**

# SEMICONDUCTOR DATA




LC7800 Equivalent circuit (DG-B unit IC109—111)




LC7800 (Top view)

| Input | | | | | | | | | | | | | | | | | | | | Output | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Data input | | | | | | | | | | | | | | | | Select input | | | | Inhibit input | | | | | |
| A | | | | B | | | | C | | | | D | | | | | | | | | | | | | |
| A0 | A1 | A2 | A3 | B0 | B1 | B2 | B3 | C0 | C1 | C2 | C3 | D0 | D1 | D2 | D3 | SA | SB | SC | SD | INH | INH | 00 | 01 | 02 | 03 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 1 | 0 | 1 | 1 | 1 | 1 |
| * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 1 | * | 1 | 1 | 1 | 1 |
| * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 0 | 1 | 1 | 1 | 1 |

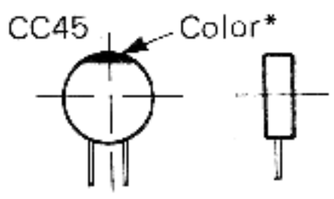
(Note) 1 : H level/0 : L level/* : don't care

LC7800 Truth table

Downloaded by
RadioAmateur.EU

**CAPACITORS** CC 45 TH 1H 220 J
1 2 3 4 5 6

1 = Type ..... ceramic, electrolyic, etc.
2 = Shape .....round, square, etc.
3 = Temp. coefficient
4 = Voltage rating
5 = Value
6 = Tolerance




- **Capacitor value**

0 1 0 = 1pF
1 0 0 = 10pF
1 0 1 = 100pF
1 0 2 = 1000pF = 0.001μF
1 0 3 = 0.01μF

2 2 0 = 22pF
1st number | Multiplier
2nd number

- **Temperature Coefficient**

| 1st Word | C | L | P | R | S | T | U |
|---|---|---|---|---|---|---|---|
| Color* | Black | Red | Orange | Yellow | Green | Blue | Violet |
| ppm/°C | 0 | −80 | −150 | −220 | −330 | −470 | −750 |

| 2nd Word | G | H | J | K | L |
|---|---|---|---|---|---|
| ppm/°C | ± 30 | ± 60 | ± 120 | ± 250 | ± 500 |

Example CC45TH = −470±60 ppm/°C

- **Tolerance**

| Code | C | D | G | J | K | M | X | Z | P | No code |
|---|---|---|---|---|---|---|---|---|---|---|
| (%) | ± 0.25 | ± 0.5 | ± 2 | ± 5 | ± 10 | ± 20 | + 40 −20 | + 80 −20 | + 100 −0 | More than 10μF−10~+50 / Less than 4.7μF−10~+75 |

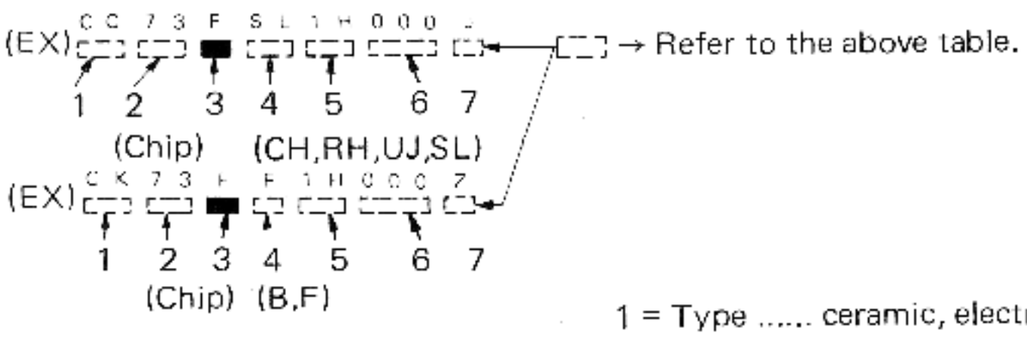
| Code | B | C | D | F | G |
|---|---|---|---|---|---|
| (pF) | ± 0.1 | ± 0.25 | ± 0.5 | ± 1 | ± 2 |

Less than 10 pF

- **Rating voltage**

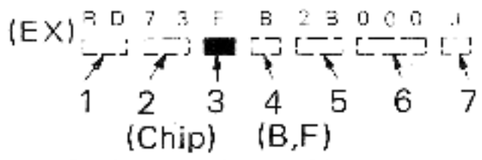
| 2nd word / 1st word | A | B | C | D | E | F | G | H | J | K | V |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0 | 1.25 | 1.6 | 2.0 | 2.5 | 3.15 | 4.0 | 5.0 | 6.3 | 8.0 | – |
| 1 | 10 | 12.5 | 16 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | 35 |
| 2 | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | – |
| 3 | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 | 4000 | 5000 | 6300 | 8000 | – |

- **Chip capacitors**

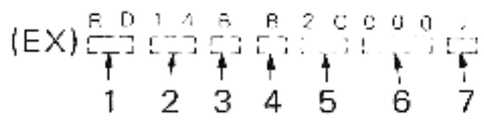



1 = Type ..... ceramic, electrolytic, etc.
2 = Shape ..... round, square, etc.
3 = Dimension
4 = Temp. coefficient
5 = Voltage rating
6 = Value
7 = Tolerance.

- **Chip resistor (Carbon)**




- **Carbon resistor (Normal type)**




**Dimension**

| Dimension code | L | W | T |
|---|---|---|---|
| Empty | 5.6 ± 0.5 | 5.0 ± 0.5 | Less than 2.0 |
| E | 3.2 ± 0.2 | 1.6 ± 0.2 | Less than 1.25 |
| F | 2.0 ± 0.3 | 1.25 ± 0.2 | Less than 1.25 |

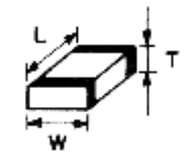
**Dimension**

| Dimension code | L | W | T | Wattage |
|---|---|---|---|---|
| E | 3.2 ± 0.2 | 1.6 ± 0.2 | 0.57 | 2B |
| F | 2.0 ± 0.3 | 1.25 ± 0.2 | 0.45 | 2A |

**Rating wattage**

| Cord | Wattage | Cord | Wattage | Cord | Wattage |
|---|---|---|---|---|---|
| 2A | 1 10W | 2E | 1 4W | 3A | 1W |
| 2B | 1 8W | 2H | 1 2W | 3D | 2W |
| 2C | 1 6W | | | | |

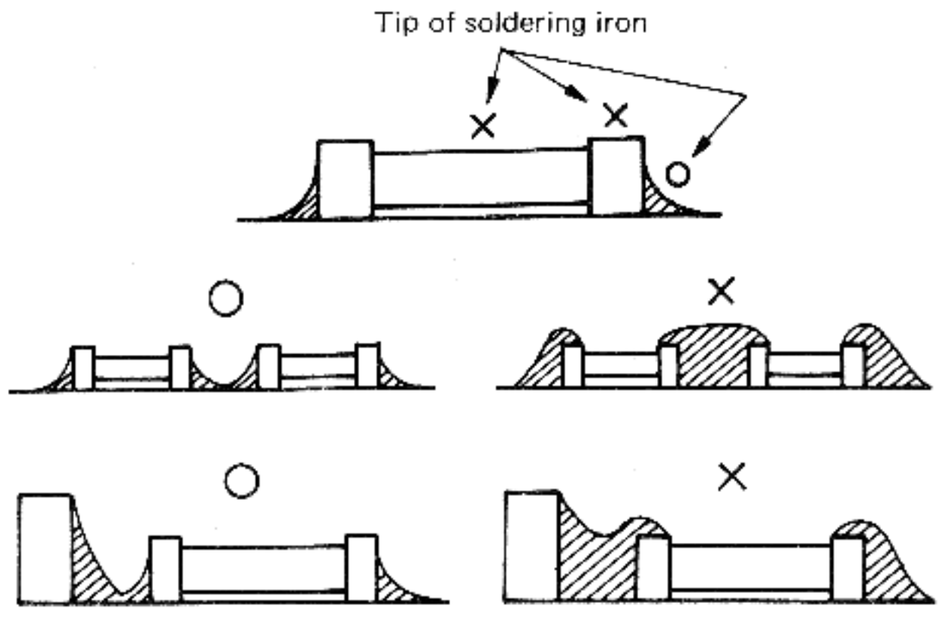
Dimension




**Note :**

**Soldering procedure for the tip condenser**

- Tools and materials
  Soldering iron
  Slit tip
  Solder (Silver solder or low temperature solder)
  Pincers made of bamboo
  Hot plate or drier
- Soldering procedure
  1) Pre-heat the surface of tip condenser up to around 150°C with the hot plate or drier.
  2) Put the solder on the tip of soldering iron.
  3) Hold and place the tip condenser on the installation place with the pincers made of bamboo.
  4) Solder one end of the tip condenser using the tip of soldering iron.
  5) Solder the other end similarly.
- Caution
  1) Flatten the solder on the pattern where the tip condenser is to be installed. Do not swell it.
  2) Length of soldering time :
  In case of silver solder : Within 6 – 8 sec.
  In case of low temperature solder : Within 3 – 4 sec.
  3) Keep the temperature of tip of soldering iron below 280°C.




**Note:** If you damage the silver plating on the ends of the capacitors, they should be discarded as they are no longer capable of performing correctly.
Use care when soldering. Liberal use of additional flux will ease the task of soldering.

## SEMICONDUCTOR

N : New parts
* : Please note that parts are sometimes not in stock and it takes much time to deliver.

| Item | Re-marks | Part No. |
|---|---|---|
| **Diode** | | 1N60 |
| | | 1N4448 |
| | | 1S1007 |
| | | 1S1555 |
| | | 1S1587 |
| | | 1S2588 |
| | | 1SS99 |
| | | 1SS133 |
| | | GM-3B |
| | | MC911 |
| | | MC921 |
| | | MC931 |
| | | MI204 |
| | | S15VB10 |
| | | U05B |
| **D.B.M.** | | ND487R1-3R |
| **Varistor** | | MV-203 |
| | | STV-3H(O,Y) |
| | | SV03YS |
| **Varactor** | | 1SV123 |
| **Voltage variable** | | 1SV54GC |
| | | 1SV149A |
| **Zener diode** | | BZ-192 |
| | | BZ-320 |
| | | BZ-350 |
| | | MTZ3.0JB |
| | | MTZ3.6JB |
| | | MTZ3.9J |
| | | MTZ3.9JB |
| | | MTZ4.3J |
| | | MTZ5.1J(A,B) |
| | | MTZ5.1JA |
| | | MTZ5.6J |
| | | MTZ5.6JA |
| | | MTZ5.6JB |
| | | MTZ6.2JB |
| | | MTZ6.8J |
| | | MTZ9.1J |
| | | MTZ9.1JA |
| | | MTZ9.1JC |
| | | MTZ10J |
| | | MTZ10J(A,B) |
| | | MTZ10JC |
| | | MTZ11JC |
| | | MTZ12J |
| | | MTZ12JC |
| | | MTZ16J(A,B) |
| | | MTZ16JA |
| | | MTZ16JC |
| | | MTZ18JA |
| | | MTZ18JC |
| | | MTZ20J |
| | | MTZ20JC |
| | | MTZ24JD |

| Item | Re-marks | Part No. |
|---|---|---|
| **LED** | | LN66(S) |
| | | LN01201C |
| | | LN01301C |
| | | LN01401C |
| | | LT8001P |
| | | SG238D |
| **Sarge absorber** | | DSA441LA |
| **Thermister** | | 25D29 |
| | | 112-103-2 |
| | | 112-501-2 |
| | | 112-503-2 |
| | | 5TP-41L |
| **Display tube** | N | 11-BT-05Z |
| **LCD** | N | FTD-7155 |
| **Photo TR** | | ON1110 |
| | | PN126S |
| **Digital TR** | | DTA114ES |
| | | DTA124ES |
| | N | DTA143EF |
| | N | DTA143ES |
| | N | DTA143XS |
| | | DTC114ES |
| | | DTC124EF |
| | | DTC124ES |
| | N | DTC144WS |
| **TR** | | 2N5885 |
| | | 2SA950(Y) |
| | | 2SA966(O) |
| | | 2SA984K(E) |
| | | 2SA1015(Y) |
| | | 2SA1048(Y) |
| | | 2SA1049(GR) |
| | | 2SA1115(E) |
| | | 2SB861(C) |
| | | 2SC496(Y) |
| | | 2SC1907 |
| | | 2SC1959(Y) |
| | | 2SC1973(T) |
| | | 2SC2053 |
| | | 2SC2075 |
| | | 2SC2120(Y) |
| | | 2SC2235(O) |
| | | 2SC2274K(E) |
| | | 2SC2458(Y) |
| | | 2SC2459(BL) |
| | | 2SC2668(Y) |
| | | 2SC2787(L) |
| | | 2SC3113(B) |
| | | 2SD880(Y) |
| | | 2SD1266(P,O) |
| | | 2SD1406(Y) |
| | | MRF422 |
| | | MRF485 |

| Item | Re-marks | Part No. |
|---|---|---|
| **FET** | | 2SK30A(GR) |
| | | 2SK30A(O) |
| | | 2SK125 |
| | | 2SK125P |
| | | 2SK192A(GR) |
| | | 2SK192A(GR)*J |
| | | 3SK73(Y) |
| **IC** | | BA718 |
| | | BU4001B |
| | | HA1368 |
| | | HD74LS138P |
| | | HD74LS245P |
| | | HD74LS245WP |
| | N | HD4410 |
| | N | HD4478 |
| | | HD10116 |
| | | HD10125 |
| | | HD10131 |
| | N | HD10551 |
| | | LC7800 |
| | | LM358P |
| | | M5L8255AP-5 |
| | | M74LS32P |
| | | M54459L |
| | | M54561P |
| | | MB3614 |
| | | MB8416-20LP-GRA |
| | | MBM2764-30T2 |
| | | MC74HC157N |
| | | MC1723C |
| | | MC10116L |
| | | MC10125L |
| | | MC10131L |
| | | MC14077BCP |
| | | MC14569BCP |
| | N | MC145158P |
| | | MN6147 |
| | | MN6147C |
| | | NE555P |
| | N | NE556N |
| | | NJM2901 |
| | | NJM2903D |
| | | NJM2904D |
| | | NJM4558S |
| | | PST518A |

| Item | Re-marks | Part No. |
|---|---|---|
| | | SN74LS32N |
| | | SN74LS73AN |
| | | SN74LS90N |
| | | SN74LS138N |
| | | SN74LS139N |
| | | SN74LS145N |
| | | SN74LS175N |
| | | SN74LS245N |
| | | SN74LS374N |
| | | SN74S10N |
| | | SN74S112N |
| | | SN16913P |
| | | TA78L008AP |
| | | TA7140P |
| | | TA7302P |
| | N | TC40H004P |
| | | TC4001BP |
| | | TC4011BP |
| | | TC4027BP |
| | | TC4040BP |
| | | TC4049BP |
| | | TC4073BP |
| | | TC5065BP |
| | | TMP8255AP-5 |
| | | μA7818UC |
| | | μPC78L05A |
| | | μPC78L08A |
| | | μPC577H |
| | | μPC1037H |
| | | μPC7805H |
| | | μPC7812H |
| | | μPC7815H |
| | | μPD8255AC-5 |
| **Micro-processor** | | LH0080A |
| | | μPD780C-1 |
| | N | μPD7508G-650-00 |

## TS-940S GENERAL

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| A01-0988-01 | N* | METALLIC CASE UPPER | 1 | |
| A01-0989-11 | N* | METALLIC CASE LOWER | 1 | |
| A20-2542-02 | N* | PANEL | 1 | |
| A23-1486-02 | N* | REAR PANEL | 1 | |
| BU4001B | | C.MOS IC 2-INPUT NOR X4 | 1 | IC 102 |
| B03-0525-04 | * | SWITCH MASK | 1 | |
| B03-0539-04 | N* | SWITCH MASK POWER,TIMER | 1 | |
| B03-0540-04 | N* | SWITCH MASK SEND/REC | 1 | |
| B03-0541-04 | N* | SWITCH MASK RIT,XIT | 1 | |
| B05-0722-04 | * | SP GRILE | 1 | |
| B10-0673-03 | N | FRONT GLASS | 1 | |
| B10-0674-04 | N | FRONT GLASS LCD | 1 | |
| B11-0426-04 | N | LIGHT GUIDING PLATE METER | 1 | |
| B30-0817-15 | | LAMP 14V 80MA | 2 | PL 1, 2 |
| B31-0656-05 | N | METER | 1 | |
| B40-3571-04 | N* | MODEL NAME PLATE TS-940S KMTW | 1 | |
| B40-3572-04 | N* | MODEL NAME PLATE TS-94X X | 1 | |
| B42-1729-04 | * | PLATE"WITH ANTENNA TUNER" | 1 | |
| B42-1739-14 | * | VOLTAGE IND' PLATE:120V K | 1 | |
| B42-1740-04 | * | VOLTAGE IND' PLATE:220V MW | 1 | |
| B42-1741-04 | * | VOLTAGE IND' PLATE:240V TX | 1 | |
| B42-2388-14 | N* | ADJ SEAL VOX CONTROL | 1 | |
| B42-2389-04 | N* | ADJ SEAL SIDE-TONE/BUZ/MONI | 1 | |
| B42-2390-04 | N* | ADJ SEAL CAR BALANCE | 1 | |
| B42-2391-23 | N* | TS-940S HF TRANSCEIVER KMTW | 1 | |
| B42-2392-23 | N* | TS-940X HF TRANS | 1 | |
| B42-2399-04 | * | FACE PLATE | 1 | |
| B43-1045-04 | N* | BADGE KENWOOD KMWX | 1 | |
| B43-1046-04 | N* | BADGE TRIO T | 1 | |
| B46-0415-00 | | USER & WARRANTY CARD K | 1 | |
| B48-0443-04 | N* | LABEL FOR PACKAG | 2 | |
| B48-0444-04 | N* | LABEL FOR PACKAG | 2 | |
| B48-0445-04 | N* | LABEL FOR PACKAG | 2 | |
| B48-0446-04 | N* | LABEL FOR PACKAG | 2 | |
| B50-8001-00 | N | INSTRUCTION MANUAL KMWX | 1 | |
| B50-8002-00 | N | INSTRUCTION MANUAL T | 1 | |
| CE04W1H010M | | ELECTRO 1 50V | 1 | C 119 |
| C90-0857-05 | | ELECTRO 22000 50V | 2 | C 108,109 |
| C91-0496-05 | | CERAMIC 470P AC125V | 2 | C 102,103 |
| C91-0647-05 | | CERAMIC 0.01 2KV | 1 | C 101 |
| DSA441LA | | SARGE ABSOBER | 1 | D 105 |
| DTC124ES | | DIGITAL TR NPN | 1 | Q 105 |
| E04-0152-05 | | UHF TYPE RECEPTACLE:ANT | 1 | J 102 |
| E06-0655-05 | N | DIN RECEPTACLE 6P ACC1 | 1 | J 109 |
| E06-0753-05 | N | DIN RECEPTACLE 7P REMOTE | 1 | J 105 |
| E06-0851-05 | | DIN RECEPTACLE 8P X.VERTER | 1 | J 104 |
| E07-0751-05 | | DIN PLUG 7P (ACCESARY) | 1 | |
| E07-0852-05 | | METAL PLUG 8P MIC MX | 1 | |
| E07-1351-05 | | PLUG ACC2 13P(ACCESSARY) | 1 | |
| E11-0404-05 | | PHONE JACK KEY,PHONE | 2 | J 101,108 |
| E11-0410-05 | | PHONE JACK EXT SP | 1 | J 107 |
| E13-0101-05 | | RCA JACK RX ANT,RTTY | 2 | J 103,106 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| E18-0351-05 | | 3P AC SOCKET | 1 | J 110 |
| E23-0015-04 | | LUG PLATE | 3 | |
| E23-0043-04 | | EARTH LUG ANT | 1 | |
| E23-0420-05 | | TERMINAL(INSIDE) | 2 | |
| E23-0425-05 | | LUG TERMINAL | 1 | |
| E30-1643-15 | | AC CORD ASS'Y M | 1 | |
| E30-1644-15 | | AC CORD ASS'Y T | 1 | |
| E30-1645-05 | | AC CORD ASS'Y W | 1 | |
| E30-1647-05 | | AC CORD ASS'Y X | 1 | |
| E30-2013-05 | N | AC CORD ASS'Y K | 1 | |
| E40-0273-05 | | MINI CONNECTOR 2P | 2 | |
| E40-0773-05 | | MINI CONNECTOR 7P | 1 | |
| E40-3007-05 | | MINI CONNECTOR 2P | 1 | |
| F05-4022-05 | | FUSE 4A MTWX | 2 | |
| F05-6021-05 | | FUSE 6A KM | 2 | |
| F07-0862-04 | N* | SLIDE COVER :ON TOP CASE | 1 | |
| F07-0863-03 | N* | HEAT SINK COVER | 1 | |
| F09-0405-34 | | FAN :POWER TRANS SIDE | 1 | |
| F15-0656-14 | N* | SWITCH MASK VOX | 1 | |
| F15-0657-04 | N* | FILTER DISPLAY | 1 | |
| F19-0620-04 | * | SHIELDING SLIDE COVER | 2 | |
| F20-0520-04 | | INSULATING SHEET(BATT TOP) | 1 | |
| F20-0521-04 | | INSULATING SHEET( SP BOTTOM ) | 2 | |
| F20-0527-05 | | INSULATING BOARD :TRANSISTOR | 2 | |
| F29-0421-14 | * | INSULATOR | 5 | |
| G01-0817-04 | * | COILED SPRING | 4 | |
| G02-0549-04 | | SPRING MOTOR | 1 | |
| G09-0405-05 | | SPRING FOR KNOB NB | 1 | |
| G09-0410-05 | | SPRING FOR KNOB VBT | 1 | |
| G11-0609-04 | * | CUSHION MIC MX | 2 | |
| G13-0649-04 | * | CUSHION (A) METER | 2 | |
| G13-0662-04 | * | CUSHION SPEAKER | 1 | |
| G13-0810-04 | N* | CUSHION CHEMI-CON BLOCK | 2 | |
| G13-0818-04 | | CUSHION | 1 | |
| G13-0819-04 | N* | CUSHION | 1 | |
| G53-0510-04 | * | PACKING PANEL | 2 | |
| G53-0511-04 | * | PACKING LED | 3 | |
| G53-0524-04 | N* | PACKING TOP CASE | 1 | |
| G53-0525-04 | N* | PACKING FILTER CASE | 1 | |
| H01-4643-24 | N* | CARTON (INSIDE) KMW | 1 | |
| H01-4644-24 | N* | CARTON (INSIDE) T | 1 | |
| H01-4645-24 | N* | CARTON (INSIDE) X | 1 | |
| H03-2248-24 | N* | CARTON (OUTSIDE) KMTW | 1 | |
| H03-2252-24 | N* | CARTON (OUTSIDE) X | 1 | |
| H10-1276-04 | * | ACCESSARY BOX M | 1 | |
| H10-2602-02 | N* | POLY' FIXTURE FRONT | 1 | |
| H10-2603-02 | N* | POLY' FIXTURE REAR | 1 | |
| H12-0491-04 | * | CUSHION KTWX | 1 | |
| H20-1426-03 | N | PROTECTIVE BAG | 1 | |
| H25-0105-04 | * | POLY.BAG,DC CABLE | 1 | |
| H25-0120-04 | * | BAG(CHARGER) | 1 | |
| J02-0049-14 | | FOOT REAR | 2 | |
| J02-0423-04 | | FOOT FRONT(OUT SIDE) | 2 | |

| PARTS NO. | NOTE | NAME & DESCRIPTION | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|
| J02-0424-04 | | FOOT | FRONT( IN SIDE) | 2 | |
| J02-0426-05 | | FOOT | SMOLL TYPE | 4 | |
| J13-0033-15 | | FUSE HOLDER | | 1 | F 101 |
| J19-1363-05 | | LEAD HOLDER | | 2 | |
| J21-4165-04 | N* | HARDWARE FIXTURE(SLIDE COVER) | | 4 | |
| J32-0762-04 | * | STUD & BOSS (STICK TYPE) | | 1 | |
| J32-0767-04 | * | STUD & BOSS (STICK TYPE) | | 2 | |
| J32-0789-04 | N | STUD & BOSS | MOTOR | 1 | |
| K01-0409-05 | | HANDLE | | 1 | |
| K21-0764-04 | | KNOB | RF,SQL,*---ETC | 4 | |
| K21-0765-04 | | KNOB | PWR,PRO*OUT | 2 | |
| K21-0766-05 | | KNOB | MAIN | 1 | |
| K23-0721-04 | | KNOB | SQL | 1 | |
| K23-0740-04 | | KNOB | AF,NOTCH,---ETC | 4 | |
| K23-0745-04 | | KNOB | MIC,PRO-IN | 2 | |
| K23-0753-04 | | KNOB | AGC,ATT,METER | 3 | |
| K23-0778-04 | N | KNOB | RIT/XIT | 1 | |
| K27-0433-04 | | PUSH KNOB | NB | 3 | |
| K27-0435-04 | | PUSH KNOB | RIT | 5 | |
| K29-0738-04 | | KNOB | CW-VBT | 1 | |
| K29-0757-04 | | PUSH KNOB | POWER | 1 | |
| K29-0761-04 | | KNOB LING | MAIN | 1 | |
| K29-3002-04 | | PUSH KNOB | VOX | 4 | |
| K29-3036-04 | | PUSH KNOB | TIMER | 1 | |
| K29-3038-04 | N | PUSH KNOB | SEND/REC | 3 | |
| L01-0256-15 | N | POWER TRANSFORME | | 1 | T 101 |
| L19-0356-05 | N | TRANSFORMER | | 1 | T 102 |
| N09-0256-05 | | SCREW | | 2 | |
| N09-0626-04 | | SEMS SCREW | M3X10 | 3 | |
| N09-0646-04 | | SCREW | M4X4 HANDLE | 2 | |
| N09-0658-04 | | SCREW | M2.6X3 MOTOR | 2 | |
| N10-2030-46 | | NUT,TR | M3 | 4 | |
| N14-0115-05 | | NUT | GND | 1 | |
| N14-0509-05 | | NUT | GND | 1 | |
| N14-0512-05 | | SPEED NUT | SLIDE COVER | 1 | |
| N15-1026-46 | | FLAT WASHER | M2.6 | 4 | |
| N15-1030-41 | | FLAT WASHER | ﾌﾛｰﾄﾓ | 2 | |
| N15-1030-46 | | FLAT WASHER,TR,SP | | 4 | |
| N15-1040-46 | | FLAT WASHER | M4 | 2 | |
| N30-2004-45 | | PAN HD SCREW | M2X4 | 2 | |
| N30-2604-45 | | PAN HD SCREW | M2.6X4 | 8 | |
| N30-2604-46 | | PAN HD SCREW | M2.6X4 | 24 | |
| N30-2605-46 | | PAN HD SCREW | M2.6X5 | 8 | |
| N30-2606-46 | | PAN HD SCREW | | 2 | |
| N30-2608-46 | | PAN HD SCREW | M2.6X8 | 5 | |
| N30-3004-46 | | PAN HD SCREW | M3X4 | 1 | |
| N30-3006-46 | | PAN HD SCREW | M3X6 | 2 | |
| N30-3014-46 | | PAN HD SCREW | M3X14 | 4 | |
| N30-4014-46 | | PAN HD SCREW | M4X14 | 1 | |
| N30-4016-46 | | PAN HD SREW | M4X16 GND | 1 | |
| N32-2606-46 | | FLAT HD SCREW | M2.6X6 | 4 | |
| N32-3006-46 | | FLAT HD SCREW | M3X6 | 14 | |
| N32-3008-46 | | FLAT HD SCREW | M3X8 | 2 | |
| N33-3006-45 | | ROUND FLAT SCREW | M3X6 | 2 | |

| PARTS NO. | NOTE | NAME & DESCRIPTION | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|
| N35-3004-45 | | BIND SCREW | M3X4 | 1 | |
| N35-3006-41 | | BIND SCREW,SUB PANEL | | 4 | |
| N35-3006-45 | | BIND SCREW | M3X6 | 2 | |
| N35-3008-45 | | BIND SCREW | M3X8 | 3 | |
| N35-4008-41 | | BIND SCREW | M4X8 | 17 | |
| N87-2606-46 | | TAPPING SCREW | M2.6X6 | 18 | |
| N87-3006-46 | | TAPPING SCREW,FOOT | | 61 | |
| N87-3010-46 | | TAPPING SCREW | M3X10 | 3 | |
| N87-3012-46 | | TAPPING SCREW | FINAL UNIT | 29 | |
| N87-4010-46 | | TAPPING SCREW | M4X10 | 4 | |
| N88-3006-46 | | FLAT TAPPING SCREW | M3X6 | 6 | |
| N89-3005-46 | | BIND TAPPING SCREW | M3X5 | 9 | |
| N89-3006-45 | | BIND TAPPING SCREW | M3X6 | 15 | |
| R90-0241-05 | | CAP. BLOCK | 0.01UF X6 | 2 | IB 101,102 |
| SG238D | | LED | GREEN | 1 | D 102 |
| S15VB10 | | DIODE | | 1 | D 101 |
| S29-2406-05 | | SWITCH | AC SELECTOR | 1 | S 103 |
| S31-1407-05 | | SLIDE SWITCH | | 1 | S 102 |
| S40-2418-05 | | PUSH SWITCH | POWER | 1 | S 101 |
| S50-1406-05 | | TACT SWITCH MIC (UP,DOWN) | MX | 2 | |
| S59-0433-15 | N | KEYBOARD ASS'Y | | 1 | |
| TC4001BP | | C.MOS IC | | | IC 102 |
| T07-0221-05 | | SPEAKER | | 1 | |
| T42-0302-05 | | DC MOTOR | FAN | 1 | M 3 |
| T91-0352-05 | N | MIC | MX | 1 | |
| UPC7805H | | AVR IC | 5 V | 1 | IC 101 |
| W02-0328-10 | | MAIN ENCODER ASS'Y | | 1 | |
| W02-0368-05 | N | LCD ASS'Y | | 1 | |
| W09-0326-05 | | LITHIUM BATTERY | BR2032 | 3 | |
| X41-1600-00 | N* | SW UNIT | A/13 TO M/13 | 1 | |
| X43-1500-00 | N* | AVR UNIT | | 1 | |
| X44-1660-00 | N* | RF UNIT | | 1 | |
| X45-1400-00 | N* | 100W FINAL UNIT | | 1 | |
| X46-1030-00 | N* | DC-DC UNIT | | 1 | |
| X48-1430-00 | N* | IF UNIT | A/2,B/2 UNIT | 1 | |
| X50-2020-00 | N* | PLL UNIT | | 1 | |
| X51-1330-00 | N* | FILTER UNIT | | 1 | |
| X53-1420-11 | N* | CONTROL UNIT | | 1 | |
| X54-1690-01 | N* | RIT ENCODER | | 1 | |
| X54-1830-00 | N* | DIGITAL A UNIT | | 1 | |
| X54-1840-00 | N* | DIGITAL B UNIT | A/2,B/2 UNIT | 1 | |
| X54-1850-00 | N* | DIGITAL C UNIT | | 1 | |
| X57-1130-00 | N* | AT UNIT | "WITH/AT"ONLY | 1 | |
| 1SS133 | | DIODE | | 3 | D 103,104,106 |
| 2N5885 | | TR | | 2 | Q 101,102 |
| 2SD1266(P,Q) | | | | 1 | Q 103 |
| 2SD1406(Y) | N | TR | | 1 | Q 104 |
| 5TP-41L | | | | 1 | TH 101 |

## SW UNIT (X41-1600-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|
| CC45CH1H220J | | CERAMIC | 22P 50V | 2 | C 3, 4 |
| CC45SL1H330J | | CERAMIC | 33P 50V | 1 | C 1 |
| CE04W1A100M | | ELECTRO | 10 10V | 1 | C 8 |
| CE04W1E220M | | ELECTRO | 22 25V | 1 | C 7 |
| CE04W1H2R2M | | ELECTRO | 2.2 50V | 1 | C 10 |
| CK45F1H103Z | | CERAMIC | 0.01 50V | 3 | C 9, 11, 12 |
| CS15E1A100M | | TANTALUM | 10 10V | 1 | C 2 |
| C91-0117-05 | | CERAMIC | 0.01 50V | 1 | C 6 |
| C91-0119-05 | | CERAMIC | 0.047 50V | 1 | C 5 |
| DTA143ES | N | DIGITAL TR | PNP | 1 | Q 5 |
| DTC124EF | | DIGITAL TR | NPN | 1 | Q 4 |
| DTC124ES | | DIGITAL TR | NPN | 2 | Q 1, 3 |
| E06-0858-05 | | 8P METAL SOCKET | | 1 | J 2 |
| E06-1351-05 | | ROUND TYPE CONNECTOR | 13P | 1 | J 3 |
| E13-0462-05 | N | JACK | 4P | 1 | J 1 |
| E23-0512-05 | | TERMINAL | 1P | 3 | |
| E40-0273-05 | | MINI CONNECTOR | 2P | 10 | |
| E40-0274-05 | | MINI CONNECTOR | 2P | 2 | |
| E40-0373-05 | | MINI CONNECTOR | 3P | 8 | |
| E40-0473-05 | | MINI CONNECTOR | 4P | 5 | |
| E40-0573-05 | | MINI CONNECTOR | 5P | 3 | |
| E40-0673-05 | | MINI CONNECTOR | 6P | 4 | |
| E40-0773-05 | | MINI CONNECTOR | 7P | 2 | |
| E40-0873-05 | | MINI CONNECTOR | 8P | 4 | |
| E40-0973-05 | | MINI CONNECTOR | 9P | 1 | |
| E40-0974-05 | | MINI CONNECTOR | 9P | 1 | |
| E40-1073-05 | | MINI CONNECTOR | 10P | 1 | |
| J31-0502-04 | * | COLLAR | PC BOAD | 7 | |
| J42-0428-05 | * | BUSHING | PC BOAD | 7 | |
| L40-1001-12 | | INDUTOR | 10 UH | 1 | L 2 |
| L40-4701-14 | | INDUCTOR | 47 UH | 1 | L 3 |
| L77-1256-05 | | XTAL | 32.758KHZ | 1 | X 1 |
| MC911 | | DIODE | | 1 | D 29 |
| MTZ10J | | ZENER DIODE | 10 V | 1 | D 20 |
| MTZ11JC | | ZENER DIODE | 11 V | 1 | D 26 |
| RC05GF2H100J | | RES. SOLID | 10 OHM 1/2W | 1 | R 56 |
| RS14AB3A180J | | METAL FILM | 18 OHM 1W | 1 | R 55 |
| RO1-0407-05 | N | POTENTIOMETER | 300(B) | 1 | R 7 |
| R12-1434-05 | | TRIM.POT. | 3K OHM | 1 | VR 13 |
| R13-3403-05 | N | SLIDE POT. | 10K(B) | 2 | R 4, 5 |
| R13-3404-05 | N | SLIDE POT. | 10K(A) | 1 | R 6 |
| R13-6402-05 | N | SLIDE POT. | 470K(B) | 2 | R 2, 3 |
| R19-3413-05 | | POTENTIOMETER | 10K(A),10K(B) | 1 | R 12 |
| R19-3421-05 | N | POTENTIOMETER | 100K(C)X2 | 1 | R 10 |
| R19-3422-05 | N | POTENTIOMETER | 10K(A),10K(B) | 1 | R 8 |
| R24-3403-05 | N | POTENTIOMETER | 10K(A)10K(B)X2 | 1 | R 9 |
| R24-9402-05 | | POTENTIOMETER | 10K(B),10K(F) | 1 | R 11 |
| R90-0515-05 | | RESISTOR BLOCK | 10K OHM X4 | 2 | IB 4, 6 |
| R90-0534-05 | | RESISTOR BLOCK | 10K OHM X5 | 1 | IB 5 |
| R90-0545-05 | | CAP. BLOCK | 0.001 X4 | 1 | IB 3 |
| R90-0546-05 | | CAP. BLOCK | 0.01 X7 | 1 | IB 1 |
| R90-0585-05 | N | DIODE BLOCK | 1S1555 X5 | 1 | IB 7 |
| S01-1430-05 | | ROTARY SWITCH | | 1 | S 13 |
| S01-1431-05 | | ROTARY SWITCH | | 1 | S 12 |
| S01-1432-05 | | ROTARY SWITCH | | 1 | S 11 |
| S29-1434-05 | N | ROTARY SWITCH | | 1 | S 2 |
| S29-2410-05 | N | ROTARY SWITCH | | 1 | S 3 |
| S31-2412-05 | N | SLIDE SWITCH | | 3 | S 22, 23, 24 |
| S31-2413-05 | N | SLIDE SWITCH | | 1 | S 25 |
| S40-2434-05 | | PUSH SWITCH | | 3 | S 14, 15, 16 |
| S40-2438-15 | | PUSH SWITCH | | 2 | S 20, 21 |
| S40-2439-15 | | PUSH SWITCH | | 3 | S 17, 18, 19 |
| S40-2440-15 | | PUSH SWITCH | | 7 | S 4, 5, 6, 7, 8, 9, 10 |
| S40-2453-05 | N | PUSH SWITCH | | 1 | S 26 |
| S50-1411-05 | | TACT SWITCH | | 1 | S 1 |
| UPC78L05A | | AVR IC | 5 V | 1 | IC 2 |
| UPD7508G-650-00 | N | MICRO-PROCESSOR | | 1 | IC 1 |
| 1N60 | | DIODE | | 3 | D 30, 31, 32 |
| 1SS133 | | DIODE | | 25 | D 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23, 24, 25, 27, 28, 33 |
| 11-BT-05Z | | DISPLAY TUBE | | 1 | V 1 |
| 2SA1048(Y) | | TR | | 1 | Q 2 |

## AVR UNIT (X43-1500-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|---|
| BZ-320 | | ZENER DIODE | 32 V | | 1 | D 3 |
| CE04W1A470M | | ELECTRO | 47 | 10V | 3 | C 9, 10, 11 |
| CE04W1E100M | | ELECTRO | 10 | 25V | 1 | C 8 |
| CE04W1E101M | | ELECTRO | 100 | 25V | 1 | C 14 |
| CE04W1E220M | | ELECTRO | 22 | 25V | 1 | C 13 |
| C90-0858-05 | | ELECTRO | 2200 | 50V | 2 | C 3, 4 |
| C90-0859-05 | | ELECTRO | 2200 | 35V | 1 | C 6 |
| C90-2014-05 | | ELECTRO | 6800 | 16V | 1 | C 12 |
| C91-0117-05 | | CERAMIC | 0.01 | 50V | 1 | C 5 |
| C91-0119-05 | | CERAMIC | 0.047 | 50V | 1 | C 7 |
| E23-0453-05 | | TERMINAL | | | 2 | |
| E23-0462-05 | N | TERMINAL | | | 5 | |
| E40-0273-05 | | MINI CONNECTOR | 2P | | 7 | |
| E40-0373-05 | | MINI CONNECTOR | 3P | | 4 | |
| E40-0473-05 | | MINI CONNECTOR | 4P | | 1 | |
| E40-0873-05 | | MINI CONNECTOR | 8P | | 1 | |
| F05-1534-05 | | FUSE | 15A | | 1 | F 1 |
| J31-0502-04 | * | COLLAR | PC BOAD | | 4 | |
| J42-0428-05 | * | BUSHING | PC BOAD | | 4 | |
| L40-1511-03 | | INDUCTOR | 150 UH | | 3 | L 1, 2, 3 |
| MTZ12JC | | ZENER DIODE | 12 V | | 1 | D 4 |
| MTZ18JC | | ZENER DIODE | 18 V | | 1 | D 8 |
| MTZ22JD | | ZENER DIODE | 22 V | | 1 | D 14 |
| MTZ9.1JA | | ZENER DIODE | 9.1V | | 1 | D 9 |
| RC05GF2H561J | | RES. SOLID | 560 OHM | 1/2W | 1 | R 21 |
| RS14AB3A2R2J | | METAL FILM | 2.2 OHM | 1W | 3 | R 1, 2, 4 |
| RS14GB3A821J | | METAL FILM | 820 OHM | 1W | 1 | R 19 |
| R12-0429-05 | | TRIM.POT. | 500 OHM | | 1 | VR 1 |
| R92-0620-05 | | CEMENT RESISTOR | 15M OHM | 5W | 1 | R 9 |
| SV03YS | | VARISTOR | | | 1 | D 6 |
| U05B | | DIODE | | | 6 | D 1, 2, 10, 11, 12, 13 |
| 1SS133 | | DIODE | | | 2 | D 5, 6 |
| 2SB861(C) | | TR | | | 1 | Q 1 |
| 2SC1959(Y) | | TR | | | 1 | Q 5 |
| 2SC2235(O) | | TR | | | 1 | Q 6 |
| 2SC2458(Y) | | TR | | | 3 | Q 2, 3, 4 |

## RF UNIT (X44-1660-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|---|
| CC45CH1H010C | | CERAMIC | 1P | 50V | 1 | C 106 |
| CC45CH1H101J | | CERAMIC | 100P | 50V | 1 | C 4 |
| CC45CH1H150J | | CERAMIC | 15P | 50V | 1 | C 3 |
| CC45CH1H220J | | CERAMIC | 22P | 50V | 3 | C 183,185,186 |
| CC45CH1H470J | | CERAMIC | 47P | 50V | 1 | C 2 |
| CC45CH1H560J | | CERAMIC | 56P | 50V | 1 | C 6 |
| CC45RH1H010C | | CERAMIC | 1P | 50V | 1 | C 89 |
| | | | | | 3 | 96,154,155 |
| CC45RH1H020C | | CERAMIC | 2P | 50V | 1 | C 152 |
| CC45RH1H030C | | CERAMIC | 3P | 50V | 1 | C 125 |
| CC45RH1H070D | | CERAMIC | 7P | 50V | 1 | C 119 |
| CC45RH1H100D | | CERAMIC | 10P | 50V | 5 | C 50, 52, 64, 93,138 |
| | | | | | 1 | 137 |
| CC45RH1H120J | | CERAMIC | 12P | 50V | 3 | C 142,143,147 |
| CC45RH1H121J | | CERAMIC | 120P | 50V | 4 | C 14, 40,116,118 |
| CC45RH1H180J | | CERAMIC | 18P | 50V | 1 | C 117 |
| CC45RH1H181J | | CERAMIC | 180P | 50V | 2 | C 31, 33 |
| CC45RH1H220J | | CERAMIC | 22P | 50V | 2 | C 144,148 |
| CC45RH1H221J | | CERAMIC | 220P | 50V | 2 | C 25, 27 |
| CC45RH1H270J | | CERAMIC | 27P | 50V | 4 | C 58, 62,139,149 |
| CC45RH1H390J | | CERAMIC | 39P | 50V | 2 | C 51, 56 |
| CC45RH1H470J | | CERAMIC | 47P | 50V | 2 | C 5, 85 |
| CC45RH1H560J | | CERAMIC | 56P | 50V | 3 | C 39, 41, 57 |
| CC45RH1H680J | | CERAMIC | 68P | 50V | 3 | C 38, 45, 63 |
| CC45RH1H820J | | CERAMIC | 82P | 50V | 2 | C 44, 46 |
| CC45SL1H020C | | CERAMIC | 2P | 50V | 1 | C 104 |
| CC45SL1H030C | | CERAMIC | 3P | 50V | 2 | C 108, 67 |
| CC45SL1H101J | | CERAMIC | 100P | 50V | 3 | C 37, 91,180 |
| CC45SL1H150J | | CERAMIC | 15P | 50V | 1 | C 105 |
| CC45SL1H220J | | CERAMIC | 22P | 50V | 1 | C 92 |
| CC45SL1H330J | | CERAMIC | 33P | 50V | 3 | C 159,162,168 |
| CC45SL1H331J | | CERAMIC | 330P | 50V | 1 | C 18 |
| CC45SL1H680J | | CERAMIC | 68P | 50V | 1 | C 99 |
| CC45SL1H681J | | CERAMIC | 680P | 50V | 1 | C 23 |
| CC45SL1H820J | | CERAMIC | 82P | 50V | 1 | C 90 |
| CC45TH1H220J | | CERAMIC | 22P | 50V | 1 | C 146 |
| CC45TH1H270J | | CERAMIC | 27P | 50V | 1 | C 141 |
| CC45TH1H330J | | CERAMIC | 33P | 50V | 1 | C 136 |
| CE04BW1E010M | | ELECTRO | 1 | 25V | 1 | C 191 |
| CE04W1E220M | | ELECTRO | 22 | 25V | 11 | C 7, 12, 21, 29, 35, 43, 48, 54, 60, 66 |
| | | | | | | 80 |
| CE04W1E4R7M | | ELECTRO | 4.7 | 25V | 1 | C 127 |
| CE04W1E470M | | ELECTRO | 47 | 25V | 2 | C 83,121 |
| CE04W1H010M | | ELECTRO | 1 | 50V | 1 | C 114 |
| CK45B1H471K | | CERAMIC | 470P | 50V | 4 | C 187,188,189,190 |
| CQ92M1H102K | | MYLAR | 0.001 | 50V | 1 | C 16 |
| CQ92M1H152K | | MYLAR | 0.0015 | 50V | 2 | C 15, 17 |
| C90-0506-05 | | ELECTRO | 0.22 | 50V | 1 | C 75 |
| C90-0817-05 | | ELECTRO | 1000 | 16V | 1 | C 134 |
| C91-0117-05 | | CERAMIC | 0.01 | 50V | 2 | C 100,101 |
| C91-0119-05 | | CERAMIC | 0.047 | 25V | 45 | C 8, 9, 10, 11, 20, 28, 30, 34, 36, 42 |
| | | | | | | 47, 49, 53, 55, 59, 61, 65, 67, 68, 69 |
| | | | | | | 70, 72, 73, 74, 76, 77, 78, 79, 81, 82 |
| | | | | | | 84, 86, 87,109,112,113,115,122,123,124 |
| | | | | | | 128,166,169,177,178 |
| C91-0667-05 | | CERAMIC | 0.0047 | 50V | 3 | C 94, 95,107 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| C91-1008-05 | | CERAMIC 0.022 50V | 5 | C 131, 132, 133, 157, 158 |
| | | | 1 | 163 |
| DTA143XS | | DIGITAL TR PNP | 1 | Q 14 |
| E04-0154-05 | | RF COAX. CONNECTOR | 9 | |
| E23-0430-05 | | TERMINAL | 1 | |
| E40-0211-05 | | MINI CONNECTOR 2P | 1 | |
| E40-0273-05 | | MINI CONNECTOR 2P | 4 | |
| E40-0373-05 | | MINI CONNECTOR 3P | 1 | |
| E40-0473-05 | | MINI CONNECTOR 4P | 3 | |
| E40-0573-05 | | MINI CONNECTOR 5P | 1 | |
| GM-38 | | DIODE | 1 | D 44 |
| L19-0324-05 | | TOROIDAL | 3 | T 1, 2, 3 |
| L19-0335-05 | | TOROIDAL | 1 | T 4 |
| L19-0347-05 | | TRANSFORMER 5.5T | 1 | T 5 |
| L32-0651-05 | | OSC COIL | 1 | L 65 |
| L32-0652-05 | | OSC COIL | 1 | L 68 |
| L32-0653-05 | | OSC COIL | 1 | L 71 |
| L33-0658-05 | | CHOKE COIL | 2 | L 82, 83 |
| L33-0685-05 | N | CHOKE COIL | 1 | L 84 |
| L34-0691-05 | | TUNING COIL | 1 | L 86 |
| L34-1124-05 | | COIL 5 6.5T | 2 | L 1, 42 |
| L34-2074-05 | | TUNING COIL | 1 | L 45 |
| L34-2080-05 | | TUNING COIL | 1 | L 2 |
| L34-2081-05 | | TUNING COIL | 1 | L 5 |
| L34-2082-05 | | TUNING COIL | 1 | L 6 |
| L34-2083-05 | | TUNING COIL | 1 | L 9 |
| L34-2085-05 | | TUNING COIL | 1 | L 11 |
| L34-2086-05 | | TUNING COIL | 1 | L 12 |
| L34-2087-05 | | TUNING COIL | 1 | L 13 |
| L34-2088-05 | | TUNING COIL | 1 | L 14 |
| L34-2089-05 | | TUNING COIL | 1 | L 15 |
| L34-2090-05 | | TUNING COIL | 1 | L 16 |
| L34-2091-05 | | TUNING COIL | 1 | L 18 |
| L34-2092-05 | | TUNING COIL | 1 | L 19 |
| L34-2093-05 | | TUNING COIL | 2 | L 20, 21 |
| L34-2094-05 | | TUNING COIL | 1 | L 22 |
| L34-2095-15 | | TUNING COIL | 1 | L 23 |
| L34-2096-05 | | TUNING COIL | 1 | L 24 |
| L34-2097-05 | | TUNING COIL | 1 | L 7 |
| L34-2098-05 | | TUNING COIL | 1 | L 10 |
| L34-2101-05 | | TUNING COIL | 1 | L 29 |
| L34-2106-05 | | TUNING COIL | 2 | L 74, 76 |
| L34-2107-05 | | TUNING COIL | 1 | L 75 |
| L34-2109-15 | | TUNING COIL | 1 | L 60 |
| L34-2111-05 | | TUNING COIL | 2 | L 53, 57 |
| L34-2112-05 | | TUNING COIL | 2 | L 54, 56 |
| L34-2113-05 | | TUNING COIL | 1 | L 55 |
| L34-2114-15 | | TUNING COIL | 3 | L 50, 51, 52 |
| L34-2161-15 | | TUNING COIL | 1 | L 40 |
| L34-2241-05 | N | TUNING COIL | 2 | L 25, 27 |
| L34-2242-05 | N | TUNING COIL | 1 | L 26 |
| L34-2243-05 | N | TUNING COIL | 2 | L 28, 30 |
| L34-2244-05 | N | TUNING COIL | 2 | L 31, 33 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| L34-2245-05 | N | TUNING COIL | 1 | L 32 |
| L34-2247-05 | | TUNING COIL | 2 | L 44, 46 |
| L40-1011-03 | | INDUCTOR 100 UH | 2 | L 61, 62 |
| L40-1021-03 | | INDUCTOR 1 MH | 2 | L 3, 41 |
| L40-1092-13 | | INDUCTOR 1 UH | 1 | L 85 |
| L40-1811-03 | | INDUCTOR 180 UH | 1 | L 59 |
| L40-2201-03 | | INDUCTOR 22 UH | 2 | L 70, 72 |
| L40-2701-03 | | INDUCTOR 27 UH | 2 | L 67, 69 |
| L40-3301-03 | | INDUCTOR 33 UH | 2 | L 64, 66 |
| L40-3391-03 | | INDUCTOR 3.3 UH | 1 | L 80 |
| L40-4701-03 | | INDUCTOR 47 UH | 6 | L 47, 63, 73, 77, 78, 79 |
| L40-4701-14 | | INDUCTOR 47 UH | 1 | L 43 |
| L40-4711-03 | | INDUCTOR 470 UH | 6 | L 4, 34, 35, 37, 38, 39 |
| L40-5691-02 | | INDUCTOR 5.6 UH | 1 | L 58 |
| L40-8291-02 | | INDUCTOR 8.2 UH | 1 | L 17 |
| MC911 | | DIODE | 1 | D 40 |
| MI204 | | DIODE | 2 | D 23, 26 |
| MTZ16JA | | ZENER DIODE 16 V | 1 | D 34 |
| MTZ3.0JB | | ZENER DIODE 3.0V | 1 | D 27 |
| MTZ3.6JB | | ZENER DIODE 3.6V | 1 | D 22 |
| MTZ5.1JA | | ZENER DIODE 5.1V | 1 | D 48 |
| MV-203 | | VARISTOR | 1 | D 25 |
| RC05GF2H221J | | RES. SOLID 220 OHM 1/2W | 2 | R 6, 15 |
| RC05GF2H331J | | RES. SOLID 330 OHM 1/2W | 1 | R 5 |
| RC05GF2H471J | | RES. SOLID 470 OHM 1/2W | 1 | R 144 |
| RC05GF2H821J | | RES. SOLID 820 OHM 1/2W | 1 | R 31 |
| RS14AB3D470J | | METAL FILM 47 OHM 2W | 2 | R 134, 135 |
| R12-1429-05 | | TRIM.POT. 500 OHM | 2 | VR 2, 3 |
| R12-3443-05 | | TRIM.POT. 10K OHM | 1 | VR 1 |
| R90-0593-05 | N | RESISTOR BLOCK 2.2KOHM X9 | 1 | RB 1 |
| SN74LS145N | | TTL IC: BCD DECIMAL DECODER | 1 | IC 1 |
| S51-1414-05 | | RELAY | 1 | RL 4 |
| S51-1420-05 | | RELAY | 3 | RL 1, 2, 3 |
| 1SS133 | | DIODE | 11 | D 28, 29, 30, 31, 32, 41, 42, 43, 45, 46, 47 |
| 1SV54GC | | VOLTAGE VARIABLE | 3 | D 33, 36, 38 |
| 1S1587 | | DIODE | 3 | D 35, 37, 39 |
| 1S2588 | | DIODE | 21 | D 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21 |
| 2SA1048(Y) | | TR | 2 | Q 13, 26 |
| 2SC1907 | | TR | 5 | Q 4, 19, 20, 22, 23 |
| 2SC1973(T) | | TR | 1 | Q 5 |
| 2SC2053 | | TR | 1 | Q 6 |
| 2SC2458(Y) | | TR | 5 | Q 15, 24, 25, 27, 28 |
| 2SC2668(Y) | | TR | 1 | Q 21 |
| 2SK125 | | FET | 2 | Q 7, 8 |
| 2SK125P | | FET PAIR | 2 | Q 9, 10 |
| 2SK192A(GR)*J | | FET | 3 | Q 16, 17, 18 |
| 3SK73(GR) | | FET | 3 | Q 1, 2, 3 |

## 100W FINAL UNIT (X45-1400-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|---|
| BZ-192 | | ZENAR DIODE | 19 V | | 1 | D 5 |
| BZ-350 | | ZENAR DIODE | 35 V | | 1 | D 1 |
| CC45SL1H271J | | CERAMIC | 270P | 50V | 1 | C 35 |
| CC45SL1H331J | | CERAMIC | 330P | 50V | 2 | C 2, 9 |
| CC45SL2H101J | | CERAMIC | 100P | 500V | 2 | C 8, 42 |
| CE04W1A471M | | ELECTRO | 470 | 10V | 1 | C 18 |
| CE04W1H100M | | ELECTRO | 10 | 50V | 1 | C 12 |
| CE04W1H101M | | ELECTRO | 100 | 50V | 1 | C 24 |
| CK45F1H103Z | | CERAMIC | 0.01 | 50V | 2 | C 23, 43 |
| CM73F2H331J | | CHIP CAP. | 330P | 500V | 1 | C 33 |
| CM73F2H391J | | CHIP CAP. | 390P | 500V | 1 | C 38 |
| CM73F2H681J | | CHIP CAP. | 680P | 500V | 1 | C 28 |
| C91-0456-05 | | CERAMIC | 0.047 | 25V | 11 | C 1, 3, 5, 11, 20, 21, 25, 26, 27, 36 37 |
| C91-0491-05 | | CHIP CAP. | 0.0047 | | 2 | C 16, 17 |
| C91-0493-05 | | CHIP CAP. | 0.47 | | 2 | C 29, 30 |
| E23-0015-04 | | LUG PLATE | | | 1 | |
| E23-0433-05 | | LUG | | | 8 | |
| F01-0927-05 | N* | HEAT SINK | | | 1 | |
| F07-0864-03 | N* | HEAT SINK COVER | | | 1 | |
| F09-0410-04 | N* | FAN | | | 1 | |
| F19-0644-04 | N* | SHIELDING MESH | | | 1 | |
| F20-0078-05 | | INSULATING PLATE | | | 6 | |
| F29-0014-05 | | INSULATING WASHER :TRANSISTOR | | | 10 | |
| G02-0549-04 | | SPRING | MOTOR | | 1 | |
| J21-4167-14 | N* | HARDWARE FIXTURE | | | 1 | |
| J21-4168-14 | N* | HARDWARE FIXTURE | | | 1 | |
| L19-0337-05 | | TRANSFORMER | | | 1 | T 2 |
| L19-0338-05 | | TRANSFORMER | | | 1 | T 3 |
| L19-0339-05 | | TRANSFORMER B | | | 1 | T 4 |
| L19-0340-05 | | TRANSFORMER A | | | 1 | T 1 |
| L33-0025-05 | | CHOKE COIL | 1 UH | | 2 | L 4, 5 |
| L33-0032-05 | | CHOKE COIL | 3 UH | | 1 | L 2 |
| L33-0617-05 | | RFC COIL | | | 4 | L 3, 7, 8, 9 |
| L33-0644-05 | | CHOKE COIL | 2.2 UH | | 1 | L 17 |
| L33-0651-05 | | CHOKE COIL | | | 2 | L 14, 15 |
| L33-0653-05 | | CHOKE COIL | | | 1 | L 16 |
| L33-0655-05 | | CHOKE COIL | | | 1 | L 13 |
| L40-1011-04 | | INDUCTOR | 100 UH | | 1 | L 10 |
| L40-1511-03 | | INDUCTOR | 150 UH | | 4 | L 6, 11, 12, 18 |
| MC1723CL | | AVR IC | | | 1 | IC 1 |
| MRF422 | | TR | | | 2 | Q 4, 5 |
| MRF485 | | TR | | | 2 | Q 2, 3 |
| N09-0623-04 | | SEMS SCREW | M3X8 | | 4 | |
| N09-0643-04 | | SCREW SEMUSE | | | 1 | |
| N09-0658-04 | | SCREW | M2.6X3 MOTOR | | 2 | |
| N35-3006-46 | | BIND SCREW,CASE(BOTTOM) | | | 5 | |
| N35-3008-46 | | BIND SCREW | M3X8 | | 5 | |

| PARTS NO. | NOTE | NAME & DESCRIPTION | | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|---|
| N87-3006-46 | | TAPPING SCREW,FOOT | | | 4 | |
| N89-3006-45 | | BIND TAPPING SCREW M3X6 | | | 10 | |
| N89-3006-46 | | BIND TAPPING SCREW M3X6 | | | 3 | |
| RS14AB3A220J | | METAL FILM | 22 OHM 1W | | 2 | R 9, 10 |
| RS14AB3D33QJ | | METAL FILM | 33 OHM 2W | | 1 | R 35 |
| R12-0072-05 | | SEMI FIXED | 470 OHM | | 1 | VR 1 |
| R12-1406-05 | | TRIM.POT. | 1K OHM | | 1 | VR 2 |
| R92-0041-25 | | FIXED RESISTOR | .47 OHM 1W | | 1 | R 21 |
| SDT1000F | | THERMISTER | 10K OHM | | 1 | TH 1 |
| STV-3H(O,Y) | | VARISTOR | | | 2 | D 2, 4 |
| T42-0302-05 | | DC MOTOR | FAN | | 1 | M 4 |
| 1N4448 | | DIODE | | | 1 | D 3 |
| 1S1555 | | DIODE | | | | D 3 |
| 2SC1959(Y) | | TR | | | 1 | Q 9 |
| 2SC2075 | | TR | | | 1 | Q 1 |
| 2SC496(Y) | | TR | | | 2 | Q 6, 8 |
| 2SD880(Y) | | TR | | | 1 | Q 7 |

## DC-DC UNIT (X46-1030-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|---|
| CE04W1H010M | | ELECTRO | 1 | 50V | 1 | C 2 |
| CE04W1H100M | | ELECTRO | 10 | 50V | 2 | C 6, 7 |
| CE04W1H220M | | ELECTRO | 22 | 50V | 2 | C 4, 5 |
| C90-2005-05 | | ELECTRO | 1000 | 25V | 1 | C 1 |
| C90-2016-05 | N | ELECTRO | 47 | 25V | 1 | C 10 |
| C91-0117-05 | | CERAMIC | 0.01 | 50V | 1 | C 9 |
| DTC124ES | | DIGITAL TR | NPN | | 1 | Q 3 |
| E40-0273-05 | | MINI CONNECTOR | 2P | | 1 | |
| E40-0373-05 | | MINI CONNECTOR | 3P | | 1 | |
| E40-0573-05 | | MINI CONNECTOR | 5P | | 1 | |
| J31-0502-04 | * | COLLAR | PC BOAD | | 2 | |
| J42-0428-05 | * | BUSHING | PC BOAD | | 2 | |
| L19-0336-05 | | TRANSFORMER | | | 1 | T 1 |
| L40-1011-12 | | INDUCTOR | 100 UH | | 1 | L 1 |
| MTZ12JC | | ZENER DIODE | 12 V | | 1 | D 6 |
| MTZ9.1JC | | ZENER DIODE | 9.1V | | 1 | D 5 |
| RC05GF2H2R2J | | RES. SOLID | 2.2 OHM 1/2W | | 1 | R 8 |
| 1N4448 | | DIODE | | | 4 | D 1, 2, 3, 4 |
| 2SC2274K(E) | | TR | | | 2 | Q 1, 2 |

## IF UNIT (X48-1430-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|---|
| BA718 | | DUAL OP-AMP | | | 2 | IC 1, 2 |
| CC45CH1H0R5C | | CERAMIC | 0.5P | 50V | 2 | C 15,265 |
| CC45CH1H010C | | CERAMIC | 1P | 50V | 1 | C 282 |
| CC45CH1H020C | | CERAMIC | 2P | 50V | 2 | C 23,278 |
| CC45CH1H100D | | CERAMIC | 10P | 50V | 3 | C 1,178,256 |
| CC45CH1H330J | | CERAMIC | 33P | 50V | 2 | C 7, 22 |
| CC45RH1H010C | | CERAMIC | 1P | 50V | 3 | C 8, 9, 10 |
| CC45RH1H121J | | CERAMIC | 120P | 50V | 1 | C 165 |
| CC45RH1H241J | | CERAMIC | 240P | 50V | 1 | C 163 |
| CC45SL1H101J | | CERAMIC | 100P | 50V | 8 | C 3, 4, 26,131,181,187,189,224 |
| CC45SL1H121J | | CERAMIC | 120P | 50V | 2 | C 118,211 |
| CC45SL1H151J | | CERAMIC | 150P | 50V | 2 | C 91,220 |
| CC45SL1H221J | | CERAMIC | 220P | 50V | 2 | C 125,176 |
| CC45SL1H391J | | CERAMIC | 390P | 50V | 1 | C 113 |
| CC45SL1H470J | | CERAMIC | 47P | 50V | 1 | C 124 |
| CC45SL1H560J | | CERAMIC | 56P | 50V | 1 | C 11 |
| CC45UJ1H101J | | CERAMIC | 100P | 50V | 1 | C 185 |
| CE04W1A470M | | ELECTRO | 47 | 10V | 1 | C 25 |
| CE04W1C330M | | ELECTRO | 33 | 16V | 17 | C 21, 28, 97,105,137,138,145,150,153,190 194,196,207,208,227,232,275 |
| CE04W1E220M | | ELECTRO | 22 | 25V | 1 | C 206 |
| CE04W1HR47M | | ELECTRO | 0.47 | 50V | 2 | C 132,144 |
| CE04W1H0R1M | | ELECTRO | 0.1 | 50V | 3 | C 123,126,128 |
| CE04W1H010M | | ELECTRO | 1 | 50V | 18 | C 61, 63, 65, 68, 70, 72, 75,103,130,139 149,188,192,195,197,199,209,281 |
| CE04W1H100M | | ELECTRO | 10 | 50V | 8 | C 140,141,142,151,191,198,201,202 |
| CE04W1H4R7M | | ELECTRO | 4.7 | 50V | 1 | C 226 |
| CQ09FS1H122J | N | POLYSTYRENE | 1200P | 50V | 3 | C 174,177,179 |
| CQ09FS1H182J | N | POLYSTYRENE | 1800P | 50V | 2 | C 87, 88 |
| CQ09FS1H392J | N | POLYSTYRENE | 3900P | 50V | 2 | C 112,162 |
| CQ92M1H273K | | MYLAR | 0.027 | 50V | 1 | C 146 |
| CQ92M1H392K | | MYLAR | 0.0039 | 50V | 2 | C 83,107 |
| CQ92M1H473K | | MYLAR | 0.047 | 50V | 1 | C 147 |
| CQ92M1H683K | | MYLAR | 0.068 | 50V | 1 | C 143 |
| C05-0314-05 | | TRIMMER | 100P | | 1 | TC 1 |
| C90-0495-05 | | FIXED ELECTRO | 47 | 6.3V | 1 | C 402 |
| C91-0117-05 | | CERAMIC | 0.01 | 50V | 28 | C 2, 12, 13, 18, 20, 24, 27, 41, 48, 53 66, 78, 89,106,122,148,152,172,200,241 247,249,261,272,273,276,277,401 |
| C91-0119-05 | | CERAMIC | 0.047 | 25V | 62 | C 19, 43, 44, 45, 49, 55, 56, 57, 58, 60 62, 64, 67, 69, 71, 76, 77, 82, 84, 86 90, 93, 95, 96,101,104,109,111,114,116 117,119,134,156,159,160,164,166,167,168 169,171,173,175,182,183,184,186,213,214 215,217,221,223,228,229,230,231,236,238 238 239,280 |
| C91-0457-05 | | CERAMIC | 0.022 | 50V | 22 | C 16, 17, 40, 42, 59, 81, 94, 98,102,127 154,157,158,216,246,248,252,257,260,267 269,274 |
| C91-0667-05 | | CERAMIC | 0.0047 | 50V | 2 | C 14,204 |
| C91-0671-05 | | CERAMIC | 0.0068 | 50V | 3 | C 135,136,193 |
| C91-1008-05 | | CERAMIC | 0.022 | 50V | 41 | C 5, 6, 29, 30, 31, 32, 34, 35, 36, 37 39, 47, 51, 52, 54, 74, 79, 80, 85, 92 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| | | | | 180,212,219,235,237,240,242,243,244,250 251,253,254,258,259,262,263,264,266,270 271 |
| DTA143EF | N | DIGITAL TR PNP | 14 | Q 401,402,403,404,405,406,407,408,409,410 411,412,413,414 |
| DTC114ES | | DIGITAL TR NPN | 5 | Q 3, 6, 18, 20, 38 |
| E04-0154-05 | | RF COAX. CONNECTOR | 3 | |
| E29-0440-14 | | GND WAFER | 2 | |
| E40-0211-05 | | MINI CONNECTOR 2P | 1 | |
| E40-0273-05 | | MINI CONNECTOR 2P | 7 | |
| E40-0373-05 | | MINI CONNECTOR 3P | 2 | |
| E40-0473-05 | | MINI CONNECTOR 4P | 9 | |
| E40-0573-05 | | MINI CONNECTOR 5P | 3 | |
| E40-0611-05 | | MINI CONNECTOR 6P | 1 | |
| E40-0618-05 | | CONNECTOR 6P | 1 | |
| E40-0711-05 | | MINI CONNECTOR 7P | 2 | |
| E40-0718-05 | | CONNECTOR 7P | 2 | |
| E40-0811-05 | | MINI CONNECTOR 8P | 1 | |
| E40-0818-05 | | CONNECTOR 8P | 1 | |
| E40-0873-05 | | MINI CONNECTOR 8P | 1 | |
| E40-0973-05 | | MINI CONNECTOR 9P | 2 | |
| E40-5059-05 | N | MINI CONNECTOR 5P | 6 | |
| J32-0761-04 | * | STUD & BOSS (STICK TYPE) | 6 | |
| LT8001P | | LED RED | 2 | D 48, 51 |
| L32-0650-15 | | OSCILLATING COIL | 4 | L 15, 18, 19, 20 |
| L34-0536-05 | | TUNING COIL | 5 | L 1, 8, 37, 38, 41 |
| L34-0781-05 | | TUNING COIL | 5 | L 2, 35, 40, 42, 43 |
| L34-0942-05 | | TUNING COIL | 2 | L 9, 10 |
| L34-0943-05 | | TUNING COIL | 4 | L 7, 11, 36, 44 |
| L34-2114-15 | | TUNING COIL | 1 | L 46 |
| L34-2117-15 | | TUNING COIL | 1 | L 45 |
| L34-2121-05 | | TUNING COIL | 1 | L 13 |
| L34-2124-05 | | TUNING COIL | 7 | L 12, 14, 29, 31, 32, 33, 34 |
| L34-2125-15 | | TUNING COIL | 3 | L 23, 24, 25 |
| L34-2127-15 | | TUNING COIL | 1 | L 16 |
| L34-2128-15 | | TUNING COIL | 1 | L 17 |
| L34-2247-05 | N | TUNING COIL | 4 | L 3, 4, 5, 6 |
| L40-1021-03 | | INDUCTOR 1 MH | 3 | L 26, 27, 28 |
| L40-1211-03 | | INDUCTOR 120 UH | 1 | L 39 |
| L40-1541-27 | | INDUCTOR 150 MH | 2 | L 21, 22 |
| L40-4715-25 | | INDUCTOR 10 UH | 1 | L 30 |
| L71-0222-05 | | MCF YK-88S1 | 1 | XF 2 |
| L71-0254-05 | N | MCF 45.05MHZ | 1 | XF 1 |
| L72-0319-05 | | CERAMIC FILTER CFW455HT | 1 | CF 2 |
| L72-0333-05 | | CERAMIC FILTER CFJ455K12 | 1 | CF 1 |
| L72-0350-05 | | CERAMIC FILTER 9285KHZ | 1 | CF 3 |
| MC911 | | DIODE | 2 | D 102,103 |
| MC921 | | DIODE | 5 | D 43, 60, 69, 76, 82 |
| | | | 5 | 63, 97,105,106,107 |
| MC931 | | DIODE | 5 | D 46, 47, 74, 80,109 |
| MTZ10J | | ZENER DIODE 10 V | 3 | D 45, 66, 71 |
| MTZ12JC | | ZENER DIODE 12 V | 1 | D 112 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| MTZ3.9J | | ZENER DIODE 3.9V | 2 | D 25, 37 |
| MTZ4.3J | | ZENER DIODE 4.3V | 1 | D 75 |
| MTZ5.1J(A,B) | | ZENER DIODE 5.1V | 1 | D 401 |
| MTZ6.2JB | | ZENER DIODE 6.2V | 1 | D 55 |
| MTZ6.8J | | ZENER DIODE 6.8V | 1 | D 2 |
| MV203 | | VARISTOR | 2 | D 65, 90 |
| ND487R1-3R | | D.B.M | 1 | D 73 |
| N30-3010-46 | | PAN HD SCREW TR | 6 | |
| RN14BK2E271F | | METAL FILM 270 OHM 1/4W | 2 | R 232,233 |
| R12-0421-05 | | TRIM.POT. 100 OHM | 1 | VR 6 |
| R12-1428-05 | | TRIM.POT. 1K OHM | 1 | VR 1 |
| R12-1429-05 | | TRIM.POT. 500 OHM | 2 | VR 8, 10 |
| R12-3443-05 | | TRIM.POT. 10K OHM | 2 | VR 3, 9 |
| R12-3450-05 | | TRIM.POT. 20K OHM | 1 | VR 5 |
| R12-4413-05 | | TRIM.POT. 50K OHM | 3 | VR 2, 4, 7 |
| R90-0588-05 | N | RESISTOR BLOCK 2.2KOHM X6 | 1 | R 403 |
| R90-0589-05 | N | RESISTOR BLOCK 2.2KOHM X4 | 1 | R 402 |
| SN74LS145N | | TTL IC: BCD DECIMAL DECODER | 1 | IC 401 |
| TA7140P | | IC MIC AMP | 1 | IC 3 |
| TA7302P | | IC PROC AMP | 1 | IC 4 |
| 1N60 | | DIODE | 4 | D 39, 40, 41, 42 |
| 1SS133 | | DIODE | 54 | D 14, 15, 16, 17, 30, 31, 32, 33, 49, 50 |
| | | | 8 | 52, 53, 54, 56, 57, 58, 59, 61, 62, 64 17, 50, 52, 54, 58, 59, 61, 64 67, 68, 70, 81, 88, 89, 91, 92, 93, 94 |
| | | | | 95, 96, 98, 99,100,101,104,108,110,111 402,403,404,405,406,407,408,409,410,411 412,413,414,415 |
| 1SV149A | N | VOLTAGE VARIABLE | 2 | D 38, 44 |
| 1S1587 | | DIODE | 34 | D 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 13, 18, 19, 20, 21, 22, 23, 24, 26, 27 28, 29, 34, 35, 36, 72, 77, 78, 79, 83 84, 85, 86, 87 |
| 112-103-2 | | THERMISTER 10K OHM | 4 | TH 1, 2, 4, 6 |
| 112-501-2 | | THERMISTER 500 OHM | 1 | TH 5 |
| 112-503-2 | | THERMISTER 50K OHM | 1 | TH 3 |
| 2SA1048(Y) | | TR | 1 | Q 25 |
| | | | 1 | 42 |
| 2SC1959(Y) | | TR | 1 | Q 35 |
| 2SC2458(Y) | | TR | 8 | Q 14, 15, 17, 19, 24, 31, 32, 39 |
| | | | 4 | 28, 40, 41, 47 |
| 2SC2459(BL) | | TR OR 2SC2240(GR) | 3 | Q 29, 30, 36 |
| 2SC2668(Y) | | TR | 1 | Q 1 |
| 2SC2787(L) | | TR | 2 | Q 9, 49 |
| 2SK125 | | FET | 2 | Q 4, 5 |
| 2SK192A(GR) | | FET | 2 | Q 16, 33 |
| 2SK30A(GR) | | FET | 5 | Q 21, 22, 23, 26, 27 |
| 3SK73(Y) | | FET | 16 | Q 2, 7, 8, 10, 11, 12, 13, 34, 37, 43 44, 45, 46, 48, 50, 51 |

## PLL UNIT (X50-2020-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|---|
| BA718 | N | DUAL OP-AMP | | | 1 | IC 18 |
| CC45CH1H010C | | CERAMIC | 1P | 50V | 1 | C 198 |
| CC45CH1H020C | | CERAMIC | 2P | 50V | 1 | C 84 |
| | | | | | 1 | 140 |
| CC45CH1H030C | | CERAMIC | 3P | 50V | 1 | C 13 |
| | | | | | 4 | 40, 59,139, 30 |
| CC45CH1H050C | | CERAMIC | 5P | 50V | 2 | C 6,150 |
| CC45CH1H060D | | CERAMIC | 6P | 50V | 1 | C 204 |
| CC45CH1H070D | | CERAMIC | 7P | 50V | 1 | C 104 |
| CC45CH1H080D | | CERAMIC | 8P | 50V | 1 | C 149 |
| | | | | | 1 | 156 |
| CC45CH1H090D | | CERAMIC | 9P | 50V | 1 | C 191 |
| CC45CH1H100D | | CERAMIC | 10P | 50V | 6 | C 7,132,141,153,155,203 |
| | | | | | 1 | 31 |
| CC45CH1H120J | | CERAMIC | 12P | 50V | 1 | C 39 |
| | | | | | 2 | 45,114 |
| CC45CH1H150J | | CERAMIC | 15P | 50V | 2 | C 10,151 |
| CC45CH1H180J | | CERAMIC | 18P | 50V | 3 | C 12, 14,154 |
| | | | | | 2 | 217,219 |
| CC45CH1H220J | | CERAMIC | 22P | 50V | 4 | C 2, 60,122,199 |
| | | | | | 4 | 125,127,136,200 |
| CC45CH1H270J | | CERAMIC | 27P | 50V | 1 | C 41 |
| CC45CH1H330J | | CERAMIC | 33P | 50V | 2 | C 17, 58 |
| | | | | | 3 | 134,144,218 |
| CC45CH1H390J | | CERAMIC | 39P | 50V | 1 | C 135 |
| CC45SL1H101J | | CERAMIC | 100P | 50V | 5 | C 4,123,176,178,179 |
| | | | | | 1 | 177 |
| CC45SL1H121J | | CERAMIC | 120P | 50V | 2 | C 157,158 |
| CC45SL1H151J | | CERAMIC | 150P | 50V | 2 | C 3,164 |
| | | | | | 1 | 100 |
| CC45SL1H181J | | CERAMIC | 180P | 50V | 1 | C 42 |
| CC45SL1H271J | | CERAMIC | 270P | 50V | 1 | C 103 |
| CC45SL1H390J | | CERAMIC | 39P | 50V | 2 | C 101,117 |
| | | | | | 1 | 113 |
| CC45SL1H560J | | CERAMIC | 56P | 50V | 2 | C 190,192 |
| CC45SL1H680J | | CERAMIC | 68P | 50V | 1 | C 126 |
| CC45SL1H820J | | CERAMIC | 82P | 50V | 1 | C 115 |
| CC45UJ1H020C | | CERAMIC | 2P | 50V | 1 | C 64 |
| | | | | | 1 | 107 |
| CC45UJ1H030C | | CERAMIC | 3P | 50V | 4 | C 68, 85, 88,108 |
| CC45UJ1H040C | | CERAMIC | 4P | 50V | 1 | C 63 |
| CC45UJ1H050C | | CERAMIC | 5P | 50V | 1 | C 65 |
| CC45UJ1H150J | | CERAMIC | 15P | 50V | 1 | C 86 |
| CC45UJ1H390J | | CERAMIC | 39P | 50V | 1 | C 66 |
| CE04W1A470M | | ELECTRO | 47 | 10V | 8 | C 20, 21, 27, 95, 97,111,170,172 |
| CE04W1C330M | | ELECTRO | 33 | 16V | 7 | C 49, 71, 82, 93,143,201,208 |
| CE04W1H0R1M | | ELECTRO | 0.1 | 50V | 1 | C 22 |
| CQ92M1H123K | | MYLAR | 0.012 | 50V | 1 | C 73 |
| CQ92M1H223K | | MYLAR | 0.022 | 50V | 1 | C 90 |
| CS15E1E010M | | TANTALUM | 1 | 25V | 1 | C 209 |
| CS15E1VR22M | | TANTALUM | 0.22 | 35V | 2 | C 184,185 |
| CS15E1VR33M | | TANTALUM | 0.33 | 35V | 2 | C 186,187 |
| CS15E1VR47M | | TANTALUM | 0.47 | 35V | 1 | C 206 |
| C05-0044-05 | | TRIM. CAP. | 30P | | 1 | TC 1 |
| C91-0084-05 | | CERAMIC | 0.0047 | 50V | 1 | C 215 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|---|
| C91-0117-05 | | CERAMIC | 0.01 | 50V | 30 | C 5, 9, 16, 33, 34, 50, 76, 79, 81, 91 |
| | | | | | | 94, 98,102,110,128,130,131,133,145,146 |
| | | | | | 6 | 106,124,129,147,159,214 |
| | | | | | 2 | 148,162,167,173,180,181,182,183,205,211 |
| C91-0119-05 | | CERAMIC | 0.047 | 25V | 5 | C 1, 29, 32,188,189 |
| | | | | | 1 | 169 |
| C91-0457-05 | | CERAMIC | 0.022 | 50V | 1 | C 77 |
| | | | | | 1 | 212 |
| C91-0667-05 | | CERAMIC | 0.0047 | 50V | 9 | C 23, 67, 70, 74,137,165,194,195,202 |
| | | | | | 3 | 62, 69,138 |
| C91-1008-05 | | CERAMIC | 0.022 | 50V | 19 | C 8, 18, 26, 28, 37, 46, 47, 48, 53, 54 |
| | | | | | | 55, 56, 80,118,119,120,121,160,168 |
| | | | | | 5 | 15, 44,105,174,210 |
| DTA124ES | | DIGITAL TR | PNP | | 1 | Q 32 |
| DTC124ES | | DIGITAL TR | NPN | | 2 | Q 30, 31 |
| E29-0434-05 | | CONNECTOR & TERM | | | 1 | |
| E40-0273-05 | | MINI CONNECTOR | 2P | | 2 | |
| E40-0373-05 | | MINI CONNECTOR | 3P | | 1 | |
| E40-0473-05 | | MINI CONNECTOR | 4P | | 2 | |
| E40-0573-05 | | MINI CONNECTOR | 5P | | 2 | |
| E40-0673-05 | | MINI CONNECTOR | 6P | | 1 | |
| E40-0873-05 | | MINI CONNECTOR | 8P | | 1 | |
| HD10551 | N | DIVIDER IC 1/10 ,11,20,22,40,44 | | | 2 | IC 5, 11 |
| J31-0502-04 | * | COLLAR | PC BOAD | | 8 | |
| J42-0428-05 | * | BUSHING | PC BOAD | | 8 | |
| L32-0675-05 | N | OSCILLATING COIL | 38MHZ | | 1 | L 7 |
| L32-0676-05 | N | OSCILLATING COIL | 105MHZ | | 1 | L 10 |
| L32-0677-05 | N | OSCILLATING COIL | 36MHZ | | 1 | L 34 |
| L34-0692-05 | | COIL | 5 4T | | 1 | L 39 |
| L34-0749-05 | | TUNING COIL | | | 2 | L 17, 18 |
| L34-0859-05 | | TUNING COIL | | | 3 | L 25, 26, 27 |
| L34-1124-05 | N | COIL | 5 6.5T | | 1 | L 30 |
| L34-2026-05 | | TUNING COIL | | | 2 | L 20, 21 |
| L34-2116-15 | | TUNING COIL | | | 2 | L 5, 6 |
| L34-2249-05 | N | TUNING COIL | | | 3 | L 22, 23, 24 |
| L40-1001-03 | | INDUCTOR | 10 UH | | 6 | L 4, 11, 14, 31, 32, 33 |
| L40-1001-12 | | INDUTOR | 10 UH | | 3 | L 36, 37, 38 |
| L40-1011-03 | | INDUCTOR | 100 UH | | 1 | L 12 |
| L40-1011-12 | | INDUCTOR | 100 UH | | 1 | L 29 |
| L40-1092-02 | | INDUCTOR | 1 UH | | 1 | L 9 |
| L40-1211-03 | | INDUCTOR | 120 UH | | 1 | L 13 |
| L40-2205-25 | | INDUCTOR | 22 UH | | 2 | L 8, 35 |
| L40-2701-03 | | INDUCTOR | 27 UH | | 1 | L 15 |
| L40-2791-02 | | INDUCTOR | 2.7 UH | | 1 | L 28 |
| L40-3301-03 | | INDUCTOR | 33 UH | | 1 | L 16 |
| L40-3382-01 | | INDUCTOR | 0.33UH | | 1 | L 19 |
| L40-4711-03 | | INDUCTOR | 470 UH | | 1 | L 2 |
| L40-8291-02 | | INDUCTOR | 8.2 UH | | 2 | L 1, 3 |
| L72-0349-05 | N | CERAMIC FILTER | SFJ10.7MA-D | | 1 | CF 1 |
| L77-0963-05 | | CRYSTAL | 20MHZ | | 1 | X 1 |
| MC145158P | N | PLL IC | | | 1 | IC 17 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| MC145698CP | | C.MOS IC PROG' DIVIDER | 1 | IC 4 |
| MC921 | | DIODE | 1 | D 5 |
| MN6147 | | PLL IC OR MN6147C | 3 | IC 8, 9, 19 |
| MN6147C | | PLL IC | | IC 8, 9, 19 |
| MTZ12J | | ZENER DIODE 12 V | 2 | D 1, 14 |
| MTZ5.1JA/B | | ZENER DIODE 5.1V | 1 | D 12 |
| MV-203 | | VARISTOR | 3 | D 20, 21, 22 |
| M54459L | | IC: DIVIDER 1/20 OR 1/100 | 1 | IC 10 |
| R90-0581-05 | N | DIODE BLOCK 1S1555 X5 | 1 | D 19 |
| R90-0582-05 | N | DIODE BLOCK 1S1555 X5 | 1 | D 18 |
| R90-0583-05 | N | DIODE BLOCK 1S1555 X3 | 1 | D 17 |
| R90-0584-05 | N | CAP. BLOCK 100P X7 | 1 | C 213 |
| R90-0591-05 | N | RESISTOR BLOCK 4.7KOHM X5 | 1 | R 34 |
| SN16913P | | D.B.M IC | 5 | IC 6, 7, 12, 13, 14 |
| SN74LS73AN | | TTL IC JK FLIP-FLOP X2 | 1 | IC 1 |
| SN74LS90N | | TTL IC COUNTER | 2 | IC 2, 3 |
| SN74S10N | | TTL IC 3-INPUT NAND X3 | 1 | IC 15 |
| SN74S112N | | TTL IC JK FLIP-FLOP X2 | 1 | IC 16 |
| 1SS133 | | DIODE | 4 | D 2, 3, 13, 16 |
| | | | 3 | 4, 8, 9 |
| 1SV123 | | VOLTAGE VARIABLE | 5 | D 6, 7, 10, 11, 15 |
| 2SA1115(E) | | TR | 1 | Q 5 |
| 2SC1907 | | TR | 2 | Q 20, 24 |
| 2SC2459(BL) | | TR OR 2SC2240(GR) | 2 | Q 28, 29 |
| 2SC2668(Y) | | TR | 15 | Q 1, 6, 7, 10, 11, 12, 15, 17, 18, 19 |
| | | | | 21, 22, 23, 25, 26 |
| 2SC2787(L) | | TR | 4 | Q 2, 3, 4, 16 |
| 2SC3113(B) | | TR | 4 | Q 8, 9, 13, 14 |
| 2SK192A(GR)*J | | FET | 1 | Q 27 |
| | | | | |
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## FILTER UNIT (X51-1330-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| CC45CH1H220J | | CERAMIC 22P 50V | 1 | C 55 |
| CC45CH1H470J | | CERAMIC 47P 50V | 1 | C 54 |
| CC45SL2H030C | | CERAMIC 3P 500V | 1 | C 76 |
| CC45SL2H050C | | CERAMIC 5P 500V | 1 | C 23 |
| CC45SL2H070D | | CERAMIC 7P 500V | 1 | C 24 |
| CC45SL2H101J | | CERAMIC 100P 500V | 6 | C 11, 22, 30, 33, 38, 39 |
| CC45SL2H120J | | CERAMIC 12P 500V | 1 | C 27 |
| CC45SL2H121J | | CERAMIC 120P 500V | 1 | C 32 |
| CC45SL2H150J | | CERAMIC 15P 500V | 2 | C 28, 42 |
| CC45SL2H151J | | CERAMIC 150P 500V | 4 | C 10, 35, 37, 41 |
| CC45SL2H181J | | CERAMIC 180P 500V | 2 | C 31, 40 |
| CC45SL2H220J | | CERAMIC 22P 500V | 4 | C 8, 9, 74, 75 |
| CC45SL2H221J | | CERAMIC 220P 500V | 5 | C 14, 16, 25, 36, 46 |
| CC45SL2H330J | | CERAMIC 33P 500V | 1 | C 12 |
| CC45SL2H331J | | CERAMIC 330P 500V | 3 | C 2, 13, 49 |
| CC45SL2H390J | | CERAMIC 39P 500V | 2 | C 21, 48 |
| CC45SL2H391J | | CERAMIC 390P 500V | 3 | C 4, 34, 50 |
| CC45SL2H470J | | CERAMIC 47P 500V | 4 | C 15, 26, 43, 44 |
| CC45SL2H471J | | CERAMIC 470P 500V | 3 | C 18, 19, 53 |
| CC45SL2H560J | | CERAMIC 56P 500V | 2 | C 29, 52 |
| CC45SL2H680J | | CERAMIC 68P 500V | 4 | C 6, 45, 47, 51 |
| CC45SL2H681J | | CERAMIC 680P 500V | 1 | C 17 |
| CC45SL2H820J | | CERAMIC 82P 500V | 2 | C 7, 20 |
| CE04W1H010M | | ELECTRO 1 50V | 1 | C 63 |
| CE04W1H100M | | ELECTRO 10 50V | 1 | C 64 |
| CM93D2H152J | | MICA 1500P 500V | 2 | C 1, 5 |
| CM93D2H222J | | MICA 2200P 500V | 1 | C 3 |
| C91-0119-05 | | CERAMIC 0.047 50V | 3 | C 58, 59, 60 |
| DTC124ES | | DIGITAL TR NPN | 5 | Q 1, 2, 3, 5, 9 |
| E04-0154-05 | | RF COAX. CONNECTOR | 1 | |
| E04-0157-05 | | RF COAX. CABLE RECEPTACLE | 1 | |
| E40-0273-05 | | MINI CONNECTOR 2P | 2 | |
| E40-0373-05 | | MINI CONNECTOR 3P | 2 | |
| E40-0473-05 | | MINI CONNECTOR 4P | 2 | |
| F11-0891-02 | N* | SHIELDING CASE | 1 | |
| J31-0502-04 | * | COLLAR PC BOAD | 8 | |
| J42-0428-05 | * | BUSHING PC BOAD | 8 | |
| L34-3038-05 | | FILTER COIL A 1.5- 2.5 MHZ | 1 | L 2 |
| L34-3039-05 | | FILTER COIL B 1.5- 2.5 MHZ | 1 | L 1 |
| L34-3041-05 | | FILTER COIL D 2.5- 4.5 MHZ | 1 | L 6 |
| L34-3043-05 | | FILTER COIL F 4.5- 7.5 MHZ | 1 | L 14 |
| L34-3051-15 | | FILTER COIL N 22 - 30 MHZ | 1 | L 4 |
| L34-3124-05 | N | FILTER COIL P 2.5- 4.5 MHZ | 1 | L 5 |
| L34-3125-05 | N | FILTER COIL Q 4.5-7.5/7.5-10 | 2 | L 10, 13 |
| L34-3126-05 | N | FILTER COIL R 7.5-10.5 MHZ | 1 | L 9 |
| L34-3127-05 | N | FILTER COIL S 22 - 30 MHZ | 1 | L 3 |
| L34-3128-05 | N | FILTER COIL T 10.5-15.5 MHZ | 1 | L 11 |
| L34-3129-05 | N | FILTER COIL U 10.5-15.5 MHZ | 1 | L 12 |
| L34-3130-05 | N | FILTER COIL V 15.5-22.0 MHZ | 2 | L 7, 8 |
| L39-0419-05 | | DETECTOR COIL | 1 | L 15 |
| L39-0420-05 | N | DETECTOR COIL C | 1 | L 16 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| L40-1011-12 | | INDUCTOR 100 UH | 8 | L 21, 22, 23, 24, 25, 26, 27, 28 |
| L40-1021-03 | | INDUCTOR 1 MH | 2 | L 19, 20 |
| L40-4791-02 | | INDUCTOR 4.7 UH | 2 | L 17, 18 |
| MTZ12J | | ZENER DIODE 12 V | 1 | D 10 |
| MTZ16JC | | ZENER DIODE 16 V | | D 3, 4, 5 |
| MTZ18JA | | ZENER DIODE 18 V | 3 | D 3, 4, 5 |
| MTZ18JC | | ZENER DIODE 18 V | 1 | D 16 |
| MTZ20JC | | ZENER DIODE 20 V | 1 | D 8 |
| MTZ24JD | | ZENER DIODE 24 V | 1 | D 7 |
| MTZ3.9JB | | ZENER DIODE 3.9V | 1 | D 13 |
| MTZ5.1JA | | ZENER DIODE 5.1V | 1 | D 11 |
| MTZ5.6J | | ZENER DIODE 5.6V | 1 | D 6 |
| M54561P | | IC INVERTER X7 | 1 | IC 3 |
| NJM2904D | | LINER IC DUAL | 1 | IC 1 |
| N87-3012-46 | | TAPPING SCREW FINAL UNIT | 8 | |
| R90-0510-05 | | RESISTOR BLOCK 4.7KOHM X8 | 1 | RB 2 |
| R90-0560-05 | | CAP.BLOCK 0.022 X5 | 1 | IB 1 |
| R90-0575-05 | | RESISTOR BLOCK 10K OHM X3 | 1 | RB 1 |
| SN74LS145N | | TTL IC: BCD DECIMAL DECODER | 1 | IC 2 |
| SV03YS | | VARISTOR | 1 | D 12 |
| S51-1424-05 | N | RELAY DS-1 24V | 14 | RL 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14 |
| 1N4448 | | DIODE | 7 | D 17, 18, 19, 20, 21, 22, 23 |
| 1SS133 | | DIODE | 4 | D 9, 14, 15, 24 |
| 1S1007 | | DIODE | 2 | D 1, 2 |
| 1S1555 | | DIODE | | D 17, 18, 19, 20, 21, 22, 23 |
| 2SA1015(Y) | | TR | 1 | Q 8 |
| 2SA1048(Y) | | TR | 1 | Q 6 |
| 2SC1959(Y) | | TR | 2 | Q 4, 7 |

## CONTROL UNIT (X53-1420-11)

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| CC45SL1H050C | | CERAMIC 5P 50V | 1 | C 65 |
| CC45SL1H100D | | CERAMIC 10P 50V | 1 | C 66 |
| CC45SL1H101J | | CERAMIC 100P 50V | 3 | C 127,156,185 |
| CC45SL1H120J | | CERAMIC 12P 50V | 2 | C 107,108 |
| CC45SL1H221J | | CERAMIC 220P 50V | 1 | C 164 |
| CC45SL1H330J | | CERAMIC 33P 50V | 2 | C 126,130 |
| CC45SL1H331J | | CERAMIC 330P 50V | 2 | C 69, 72 |
| CC45SL1H470J | | CERAMIC 47P 50V | 2 | C 55,132 |
| CE04W1A470M | | ELECTRO 47 10V | 1 | C 89 |
| CE04W1C100M | | ELECTRO 10 16V | 5 | C 91,105,134,142,160 |
| CE04W1C102M | | ELECTRO 1000 16V | 1 | C 111 |
| CE04W1C220M | | ELECTRO 22 16V | 6 | C 4, 8, 30, 48, 50, 60 |
| CE04W1C221M | | ELECTRO 220 16V | 1 | C 157 |
| CE04W1C330M | | ELECTRO 33 16V | 7 | C 90, 97,129,136,153,155,159 |
| CE04W1C470M | | ELECTRO 47 16V | 5 | C 92,109,112,168,178 |
| CE04W1E100M | | ELECTRO 10 25V | 3 | C 2, 31,149 |
| CE04W1E470M | | ELECTRO 47 25V | 4 | C 175,176,177,179 |
| CE04W1HR33M | | ELECTRO 0.33 50V | 1 | C 180 |
| CE04W1HR47M | | ELECTRO 0.47 50V | 7 | C 11, 12, 17, 62, 77,145,158 |
| CE04W1HOR1M | | ELECTRO 0.1 50V | 3 | C 78, 96,172 |
| CE04W1H010M | | ELECTRO 1 50V | 11 | C 1, 3, 32, 33, 63,135,140,141,146,161 171 |
| CE04W1H3R3M | | ELECTRO 3.3 50V | 1 | C 9 |
| CE04W1H470M | | ELECTRO 47 50V | 1 | C 49 |
| CK45B1H152K | | CERAMIC 1500P 50V | 1 | C 133 |
| CQ92M1H102K | | MYLAR 0.001 50V | 2 | C 104,124 |
| CQ92M1H103K | | MYLAR 0.01 50V | 5 | C 13, 15, 76, 84, 85 |
| CQ92M1H104K | | MYLAR 0.1 50V | 1 | C 110 |
| CQ92M1H152K | | MYLAR 0.0015 50V | 2 | C 138,139 |
| CQ92M1H153K | | MYLAR 0.015 50V | 1 | C 127 |
| CQ92M1H182K | | MYLAR 0.0018 50V | 2 | C 128,162 |
| CQ92M1H222K | | MYLAR 0.0022 50V | 1 | C 137 |
| CQ92M1H223K | | MYLAR 0.022 50V | 3 | C 14, 23, 88 |
| CQ92M1H333K | | MYLAR 0.033 50V | 2 | C 98,152 |
| CQ92M1H392K | | MYLAR 0.0039 50V | 3 | C 100,101,102 |
| CQ92M1H472K | | MYLAR 0.0047 50V | 6 | C 86,125,131,148,163,166 |
| CQ92M1H473K | | MYLAR 0.047 50V | 6 | C 24, 25, 29, 87, 99,103 |
| CQ92M1H562K | | MYLAR 0.0056 50V | 2 | C 45,151 |
| CQ92M1H683K | | MYLAR 0.068 50V | 1 | C 167 |
| C90-0478-05 | | ELECTRO 10 16V | 1 | C 165 |
| C90-0506-05 | | ELECTRO 0.22 50V | 1 | C 26 |
| C90-0825-05 | | ELECTRO 22 16V | 3 | C 75,147,154 |
| C91-0117-05 | | CERAMIC 0.01 50V | 10 | C 5, 7, 10, 16, 28, 35, 73, 95,113,174 |
| C91-0119-05 | | CERAMIC 0.047 25V | 16 | C 21, 38, 39, 40, 43, 44, 74,144 22, 58, 64, 67,118,122,148,173 |
| C91-0457-05 | | CERAMIC 0.022 50V | 2 | C 53, 54 |
| C91-1008-05 | | CERAMIC 0.022 50V | 18 | C 19, 37, 42, 47, 57, 70, 81, 82, 83, 94 114,115,116,117,119,120,121,170 |
| DTA143XS | N | DIGITAL TR PNP | 3 | Q 22, 51, 54 |
| DTC124ES | | DIGITAL TR NPN | 8 | Q 39, 48, 49, 50, 56, 60, 61, 68 |
| DTC144WS | N | DIGITAL TR NPN | 4 | Q 30, 31 |
| | N | | | 40, 52 |
| E23-0512-05 | | TERMINAL 1P | 1 | |
| E40-0273-05 | | MINI CONNECTOR 2P | 22 | |

| PARTS NO. | NOTE | NAME & DESCRIPTION | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|
| E40-0373-05 | | MINI CONNECTOR | 3P | 5 | |
| E40-0473-05 | | MINI CONNECTOR | 4P | 8 | |
| E40-0573-05 | | MINI CONNECTOR | 5P | 4 | |
| E40-0673-05 | | MINI CONNECTOR | 6P | 3 | |
| E40-0873-05 | | MINI CONNECTOR | 8P | 1 | |
| G53-0511-04 | | PACKING | LED | 1 | |
| HA1368 | | IC | AF PA | 1 | IC 15 |
| LT8001P | | LED | RED | 2 | D 49, 63 |
| L30-0199-05 | | IFT | 455 KHZ | 1 | L 10 |
| L30-0503-05 | | IFT | 455 KHZ | 1 | L 11 |
| L34-0535-05 | | TUNING COIL | 8.83MHZ | 1 | L 2 |
| L34-0536-05 | | TUNING COIL | | 1 | L 3 |
| L40-1011-13 | | INDUCTOR | 100 UH | 1 | L 6 |
| L40-1021-03 | | INDUCTOR | 1 MH | 1 | L 8 |
| L40-3325-04 | | INDUCTOR | 3.3 MH | 1 | L 9 |
| L40-3391-13 | | INDUCTOR | 3.3 UH | 1 | L 7 |
| L40-4711-13 | | INDUCTOR | 470 UH | 3 | L 1, 4, 5 |
| L72-0342-05 | | CERAMIC FILTER | CFV455F | 1 | CF 1 |
| L79-0446-05 | | CERAMIC DISCRI. | CFY455S | 1 | L 12 |
| MB3614 | | LINEAR IC | QUADRUPLE | 1 | IC 9 |
| MC911 | | DIODE | | 2 | D 35, 60 |
| MC921 | | DIODE | | 2 | D 41, 84 |
| | | | | 1 | 45 |
| MTZ10JC | | ZENER DIODE | 10 V | 1 | D 37 |
| MTZ12J | | ZENER DIODE | 12 V | 1 | D 52 |
| MTZ12JC | | ZENER DIODE | 12 V | 1 | D 20 |
| MTZ20JC | | ZENER DIODE | 20 V | 1 | D 54 |
| MTZ3.6JB | | ZENER DIODE | 3.6V | 1 | D 47 |
| MTZ5.6JA | | ZENER DIODE | 5.6V | 1 | D 51 |
| MTZ9.1J | | ZENER DIODE | 9.1V | 1 | D 25 |
| MV-203 | | VARISTOR | | 1 | D 42 |
| NJM2903D | | LINEAR IC | DUAL | 1 | IC 10 |
| NJM4558S | | LINEAR IC | DUAL | 2 | IC 13, 14 |
| N10-2030-41 | | HEX.NUT | | 5 | |
| N30-3008-41 | | PAN HD SCREW | M3X8,IC | 3 | |
| N30-3010-41 | | PAN HD SCREW | M3X10 | 2 | |
| N87-2606-41 | | TAPPING SCREW | M2.6X6 | 3 | |
| N87-3006-41 | | TAPPING SCREW | M3X6 | 2 | |
| RN14BK2E1002F | | METAL FILM | 10K OHM 1/4W | 1 | R 113 |
| RN14BK2E1802F | | METAL FILM | 18K OHM 1/4W | 2 | R 111,112 |
| RN14BK2E9301F | | METAL FILM | 9.3KOHM 1/4W | 1 | R 100 |
| RS14AB3A911J | | METAL FILM | 910 OHM 1W | 1 | R 52 |
| R12-1428-05 | | TRIM.POT. | 1K OHM | 1 | VR 14 |
| R12-1429-05 | | TRIM.POT. | 500 OHM | 1 | VR 10 |
| R12-3443-05 | | TRIM.POT. | 10K OHM | 5 | VR 1, 3, 8, 16, 19 |
| R12-3450-05 | | TRIM.POT. | 20K OHM | 1 | VR 4 |
| R12-4413-05 | | TRIM.POT. | 50K OHM | 7 | VR 2, 5, 6, 12, 13, 15, 18 |
| R12-5420-05 | | TRIM.POT. | 100KOHM | 2 | VR 7, 9 |
| R12-7408-05 | | TRIM.POT. | 500KOHM | 2 | VR 11, 17 |
| SV03YS | | VARISTOR | | 1 | D 57 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|
| S51-1404-05 | | RELAY | G2E DC12V | 1 | RL 2 |
| S51-2416-05 | N | RELAY | DS-2 DC24V | 1 | RL 1 |
| TA78L008AP | | AVR IC | 8 V | 1 | IC 17 |
| TC4001BP | | C.MOS IC | | 1 | IC 1 |
| TC4011BP | | C.MOS IC | 2-INPUT NAND X4 | 2 | IC 2, 5 |
| TC40498P | | C.MOS IC | BUFFER X6 | 1 | IC 3 |
| TC4073BP | | C.MOS IC | 3-INPUT AND X3 | 1 | IC 4 |
| UA7818UC | | AVR IC | 18V | 1 | IC 8 |
| UPC1037H | | IC | D.B.M | 1 | IC 16 |
| UPC577H | | IC | RF/IF AMP. | 2 | IC 11, 12 |
| UPC7815H | | AVR IC | 15V | 2 | IC 6, 7 |
| 1N60 | | DIODE | | 7 | D 61, 62, 64, 65, 78, 82, 83 |
| 1SS133 | | DIODE | | 63 | D 1, 2, 3, 4, 5, 6, 7, 8, 9, 10<br>11, 12, 13, 14, 15, 16, 17, 18, 19, 21<br>22, 23, 24, 26, 27, 28, 29, 30, 31, 32<br>33, 34, 36, 39, 40, 43, 44, 46, 50, 53<br>56, 58, 59, 66, 67, 68, 69, 70, 72, 73<br>74, 75, 76, 77, 79, 80, 81, 86, 88, 89<br>90, 91, 92 |
| 1SS99 | | DIODE | | 1 | D 55 |
| 1S1587 | | DIODE | | 2 | D 71, 94 |
| 2SA1048(Y) | | TR | | 5 | Q 4, 59<br>23, 25, 27 |
| 2SA984K(E) | | TR | | 2 | Q 28, 29 |
| 2SC2458(Y) | | TR | | 7 | Q 2, 6, 9, 10, 24, 37, 38 |
| | | | | 20 | 3, 5, 7, 8, 11, 17, 18, 19, 20, 21<br>26, 32, 34, 35, 36, 41, 42, 46, 47, 63 |
| 2SC2459(BL) | | TR | OR 2SC2240(GR) | 1 | Q 1 |
| | | | | 3 | 62, 64, 65 |
| 2SC2787(L) | | TR | | 6 | Q 13, 15, 16, 45, 58<br>14 |
| 2SK192A(GR)*J | | FET | | 2 | Q 12, 57 |
| 2SK30A(O) | | FET | | 3 | Q 33, 43, 44 |

## RIT ENCODER UNIT (X54-1690-01)

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| CE04W0J101M | | ELECTRO 100 6.3V | 1 | C 1 |
| LM358P | | LINEAR IC DUAL | 1 | IC 1 |
| N32-2606-46 | | FLAT HD SCREW M2.6X6 | 2 | |
| ON1110 | | PHOTO TR | 2 | HIT 1, 2 |
| R12-2409-05 | | TRIM. POT. 5K OHM | 2 | VR 1, 2 |

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## DIGITAL A UNIT (X54-1830-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| CC45SL1H270J | | CERAMIC 27P 50V | 2 | C 5, 6 |
| CE04W1A221M | | ELECTRO 220 10V | 1 | C 12 |
| CE04W1H010M | | ELECTRO 1 50V | 1 | C 3 |
| CQ92M1H104K | | MYLAR 0.1 50V | 1 | C 7 |
| CS15E1A100M | | TANTALUM 10 10V | 1 | C 10 |
| C90-2001-05 | | ELECTRO 470 16V | 1 | C 1 |
| C91-0119-05 | | CERAMIC 0.047 50V | 6 | C 8, 9, 14, 15, 16, 30 |
| C91-0757-05 | | CERAMIC 0.001 50V | 2 | C 17, 18 |
| C91-0761-05 | | CERAMIC 0.0022 50V | 1 | C 20 |
| C91-0769-05 | | CERAMIC 0.01 50V | 11 | C 11, 13, 21, 22, 23, 24, 25, 26, 27, 28, 29 |
| C91-1008-05 | | CERAMIC 0.022 50V | 1 | C 19 |
| DTA114ES | | DIGITAL TR PNP | 1 | Q 8 |
| | | | 2 | 9, 10 |
| DTA124ES | | DIGITAL TR PNP | 1 | Q 7 |
| E02-0122-05 | | IC SOCKET 24P | 1 | |
| E02-0123-05 | N | IC SOCKET 28P | 1 | |
| E23-0437-05 | | TERMINAL (INSIDE | 1 | |
| E23-0512-05 | | TERMINAL 1P | 1 | |
| E40-0273-05 | | MINI CONNECTOR 2P | 3 | |
| E40-0373-05 | | MINI CONNECTOR 3P | 4 | |
| E40-0673-05 | | MINI CONNECTOR 6P | 3 | |
| E40-0773-05 | | MINI CONNECTOR 7P | 1 | |
| E40-0873-05 | | MINI CONNECTOR 8P | 1 | |
| E40-0973-05 | | MINI CONNECTOR 9P | 1 | |
| E40-1073-05 | | MINI CONNECTOR 10P | 2 | |
| E40-1173-05 | | MINI CONNECTOR 11P | 1 | |
| E40-1273-05 | | PIN ASS'Y 12P | 1 | |
| HD74LS138P | | TTL IC: 3 TO 8 DEMULTIPLEXER | 1 | IC 7 |
| HD74LS245P | | TTL IC 3STATES BUS X8 | 1 | IC 10 |
| HD74LS245WP | | TTL IC 3STATES BUS X8 | 1 | IC 10 |
| J31-0502-04 | * | COLLAR PC BOAD | 6 | |
| J31-0503-05 | | BEADS | 8 | |
| J32-0767-04 | | STUD & BOSS (STICK TYPE) | 2 | |
| J42-0428-05 | * | BUSHING PC BOAD | 6 | |
| LH0080A | | MICRO-PROCESSOR | 1 | IC 1 |
| L78-0011-05 | N | CERAMIC RESONATOR 2.45MHZ | 1 | X 1 |
| MBM2764-30T2 | N | N.MOS IC EP.ROM (8KX8) | 1 | IC 2 |
| MB8416-20LP-GRA | | C.MOS IC SR.RAM (2K X8) | 1 | IC 3 |
| M5L8255AP-5 | | IC:PROGRAMABLE EXPANDER I/O | 3 | IC 4, 5, 6 |
| M74LS32P | | TTL IC 2-INPUT OR X4 | 2 | IC 13, 14 |
| N10-2026-46 | | HEX.NUT | 2 | |
| PST518A | | SYSTEM RESET IC (VS=4.0-4.4V) | 1 | IC 21 |
| R90-0188-05 | | CAP. BLOCK 0.01UF X4 | 1 | IB 9 |
| R90-0241-05 | N | CAP. BLOCK 0.01UF X6 | 1 | IB 1 |
| R90-0510-05 | | RESISTOR BLOCK 4.7KOHM X8 | 1 | RB 2 |
| R90-0533-05 | | RESISTOR BLOCK 10K OHM X10 | 1 | RB 1 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| R90-0545-05 | | CAP. BLOCK 0.001 X4 | 1 | IB 10 |
| R90-0552-05 | | CAP. BLOCK 0.01UF X8 | 4 | IB 2, 3, 5, 6 |
| R90-0586-05 | N | CAP. BLOCK 0.01UF X10 | 1 | IB 4 |
| SN74LS138N | | TTL IC: 3 TO 8 DEMULTIPLEXER | 1 | IC 7 |
| SN74LS139N | | TTL IC 2 TO 4 DEMULTIPLEX' X2 | 1 | IC 8 |
| SN74LS175N | | TTL IC D FLIP-FLOP X4 | 1 | IC 19 |
| SN74LS245N | | TTL IC 3STATES BUS X8 | 1 | IC 10 |
| SN74LS32N | | TTL IC 2-INPUT OR X4 | 2 | IC 13, 14 |
| SN74LS374N | | TTL IC: 3STATES D FLIP-FLOP X8 | 1 | IC 18 |
| TA57 | | TR. ARRAY NPN X5 | 2 | IC 16, 17 |
| TC40H004P | N | C.MOS IC INVERTER X6 | 1 | IC 15 |
| TC40118P | | C.MOS IC 2-INPUT NAND X4 | 2 | IC 11, 12 |
| TC4040BP | | C.MOS IC:12STG BINARY COUNTER | 1 | IC 9 |
| TMP8255AP-5 | | IC:PROGRAMABLE EXPANDER I/O | 3 | IC 4, 5, 6 |
| UPD780C-1 | | MICRO-PROCESSOR | 1 | IC 1 |
| UPD8255AC-5 | | IC:PROGRAMABLE EXPANDER I/O | 3 | IC 4, 5, 6 |
| 1SS133 | | DIODE | 1 | D 1 |
| | | | 2 | 3, 4 |
| 2SA1049(GR) | | TR | 3 | Q 4, 5, 6 |
| 2SC1959(Y) | | TR | 1 | Q 3 |

## DIGITAL B UNIT (X54-1840-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| CC45CH1H030C | | CERAMIC 3P 50V | 1 | C 22 |
| | | | 1 | 43 |
| CC45CH1H100D | | CERAMIC 10P 50V | 2 | C 5, 26 |
| | | | 1 | 53 |
| CC45CH1H220J | | CERAMIC 22P 50V | 1 | C 89 |
| CC45CH1H330J | | CERAMIC 33P 50V | 3 | C 10, 19, 30 |
| | | | 1 | 40 |
| CC45RH1H030C | | CERAMIC 3P 50V | 1 | C 92 |
| CC45RH1H050C | | CERAMIC 5P 50V | 1 | C 93 |
| CC45SL1H121J | | CERAMIC 120P 50V | 1 | C 74 |
| CC45SL1H151J | | CERAMIC 150P 50V | 2 | C 8, 27 |
| CC45SL1H331J | | CERAMIC 330P 50V | 2 | C 7, 28 |
| CC45SL1H390J | | CERAMIC 39P 50V | 1 | C 76 |
| CC45SL1H560J | | CERAMIC 56P 50V | 1 | C 52 |
| CC45UJ1H030C | | CERAMIC 3P 50V | 3 | C 17, 38, 44 |
| CC45UJ1H050C | | CERAMIC 5P 50V | 1 | C 23 |
| CC45UJ1H220J | | CERAMIC 22P 50V | 1 | C 41 |
| CC45UJ1H330J | | CERAMIC 33P 50V | 1 | C 20 |
| CE04W1A101M | | ELECTRO 100 10V | 2 | C 111,113 |
| CE04W1A470M | | ELECTRO 47 10V | 2 | C 47, 72 |
| CE04W1C330M | | ELECTRO 33 16V | 2 | C 16, 37 |
| CQ92M1H393K | | MYLAR 0.039 50V | 1 | C 35 |
| CQ92M1H473K | | MYLAR 0.047 50V | 1 | C 14 |
| C05-0044-05 | | TRIM. CAP 30P | 3 | TC 1, 2, 3 |
| C91-0117-05 | | CERAMIC 0.01 50V | 10 | C 1, 2, 3, 4, 9, 13, 32, 34, 70, 80 |
| | | | 5 | 11, 51, 78, 90, 91 |
| C91-0119-05 | | CERAMIC 0.047 25V | 3 | C 79,101,112 |
| | | | 1 | 106 |
| C91-0457-05 | | CERAMIC 0.022 50V | 4 | C 31, 55, 67, 69 |
| | | | 2 | 48, 77 |
| C91-0667-05 | | CERAMIC 0.0047 50V | 2 | C 15, 36 |
| | | | 5 | 18, 21, 39, 42, 49 |
| C91-0757-05 | | CERAMIC 0.001 50V | 1 | C 102 |
| | | | 7 | 103,104,105,107,108,109,110 |
| C91-1008-05 | | CERAMIC 0.022 50V | 12 | C 6, 12, 29, 33, 56, 66, 71, 82, 83, 84 |
| | | | 4 | 85, 87<br>57, 58, 60, 63 |
| DTC114ES | | DIGITAL TR NPN | 1 | Q 105 |
| DTC124ES | | DIGITAL TR NPN | 2 | Q 104,107 |
| DTC144WS | | DIGITAL TR NPN | 2 | Q 103,106 |
| E40-0273-05 | | MINI CONNECTOR 2P | 1 | |
| E40-0373-05 | | MINI CONNECTOR 3P | 1 | |
| E40-0473-05 | | MINI CONNECTOR 4P | 5 | |
| E40-0573-05 | | MINI CONNECTOR 5P | 2 | |
| E40-0873-05 | | MINI CONNECTOR 8P | 1 | |
| E40-0973-05 | | MINI CONNECTOR 9P | 1 | |
| E40-1073-05 | | MINI CONNECTOR 10P | 1 | |
| E40-1174-05 | | MINI CONNECTOR 11P L TYPE | 1 | |
| E40-1274-05 | | MINI CONNECTOR 12P L TYPE | 1 | |
| E40-1373-05 | | MINI CONNECTOR 13P | 1 | |
| E40-3007-05 | | MINI CONNECTOR 2P | 1 | |
| J31-0502-04 | * | COLLAR PC BOAD | 5 | |
| J42-0428-05 | * | BUSHING PC BOAD | 5 | |

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| LC7800 | | IC:4 TO 1 DATA SELECTOR X4 | 3 | IC 109,110,111 |
| L30-0516-05 | | IFT | 1 | L 15 |
| L32-0678-05 | N | OSCILLATING COIL 45.5MHZ | 1 | L 6 |
| L32-0679-05 | N | OSCILLATING COIL 71.5MHZ | 1 | L 10 |
| L33-0684-05 | N | CHOKE COIL 33 UH | 2 | L 4, 8 |
| L34-0536-05 | | TUNING COIL | 1 | L 14 |
| L34-0683-05 | | TUNING COIL | 2 | L 19, 20 |
| L40-1001-12 | | INDUTOR 10 UH | 1 | L 21 |
| L40-1011-03 | | INDUCTOR 100 UH | 2 | L 102,103 |
| L40-1011-13 | | INDUCTOR 100 UH | 1 | L 101 |
| L40-1211-03 | | INDUCTOR 120 UH | 4 | L 1, 2, 3, 18 |
| L40-1511-03 | | INDUCTOR 150 UH | 1 | L 12 |
| L40-1592-02 | | INDUCTOR 1.5 UH | 1 | L 11 |
| L40-1811-03 | | INDUCTOR 180 UH | 1 | L 13 |
| L40-2201-03 | | INDUCTOR 22 UH | 1 | L 9 |
| L40-2215-25 | | INDUCTOR 10 UH | 1 | L 16 |
| L40-2715-25 | | INDUCTOR 10 UH | 1 | L 17 |
| L40-4701-03 | | INDUCTOR 47 UH | 1 | L 5 |
| L40-5691-02 | | INDUCTOR 5.6 UH | 1 | L 7 |
| L72-0350-05 | N | CERAMIC FILTER 9285KHZ | 1 | CF 1 |
| L72-0351-05 | N | CERAMIC FILTER 8.83MHZ | 1 | CF 2 |
| L77-1271-05 | N | CRYSTAL 9MHZ | 2 | X 1, 2 |
| MC74HC157N | | IC:2 TO 1 DATA SELECTOR X4 | 1 | IC 112 |
| MN6147 | | PLL IC OR MN6147C | 2 | IC 1, 2 |
| MN6147C | | PLL IC | | IC 1, 2 |
| MV-203 | | VARISTOR | 2 | D 11, 12 |
| M54459L | | IC: DIVIDER 1/20 OR 1/100 | 2 | IC 3, 5 |
| N87-2606-46 | | TAPPING SCREW M2.6X6 | 4 | |
| N87-3006-46 | | TAPPING SCREW,FOOT | 3 | |
| N87-3012-46 | | TAPPING SCREW FINAL UNIT | 5 | |
| R90-0123-05 | | RESISTOR BLOCK 4.7KOHM X4 | 1 | RB 101 |
| R90-0584-05 | | CAP. BLOCK 100P X7 | 1 | C 94 |
| SN16913P | | D.B.M IC | 2 | IC 4, 6 |
| TC4011BP | | C.MOS IC 2-INPUT NAND X4 | 8 | IC 101,102,103,104,105,106,107,108 |
| 1SS133 | | DIODE | 11 | D 101,103,104,105,116,118,122,125,126,128 |
| | | | | 137 |
| | | | 26 | 102,105,106,107,108,109,110,111,112,113 |
| | | | | 114,117,119,120,121,123,124,127,129,130 |
| | | | | 131,132,133,134,135,136 |
| 1SV123 | | VOLTAGE VARIABLE | 4 | D 4, 5, 7, 8 |
| 1S1587 | | DIODE | 4 | D 1, 2, 3, 6 |
| | | | 2 | 9, 10 |
| 2SC2458(Y) | | TR | 7 | Q 12, 13, 14, 15, 17,101,102 |
| 2SC2668(Y) | | TR | 4 | Q 4, 5, 9, 10 |
| 2SC2787(L) | | TR | 4 | Q 1, 6, 11, 16 |
| 2SC3113(B) | | TR | 4 | Q 2, 3, 7, 8 |
| 3SK73(GR) | | FET | 1 | Q 18 |

## DIGITAL C UNIT (X54-1850-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| CE04W1A101M | | ELECTRO 100 10V | 1 | C 2 |
| CE04W1H101M | | ELECTRO 100 50V | 1 | C 5 |
| C91-0119-05 | | CERAMIC 0.047 50V | 1 | C 1 |
| E23-0512-05 | | TERMINAL 1P | 1 | |
| E40-3007-05 | | MINI CONNECTOR 2P | 1 | |
| E40-3008-05 | | MINI CONNECTOR 3P | 1 | |
| E40-3010-05 | | MINI CONNECTOR 5P | 1 | |
| E40-3011-05 | | MINI CONNECTOR 6P | 2 | |
| E40-3012-05 | | MINI CONNECTOR 7P | 1 | |
| E40-3013-05 | | MINI CONNECTOR 8P | 2 | |
| E40-3017-05 | | MINI CONNECTOR 12P | 2 | |
| J31-0502-04 | * | COLLAR PC BOAD | 2 | |
| J42-0428-05 | * | BUSHING PC BOAD | 2 | |
| L40-4711-13 | | INDUCTOR 470 UH | 2 | L 1, 2 |
| MTZ9.1JC | | ZENER DIODE 9.1V | 1 | D 1 |
| R90-0520-05 | | RESISTOR BLOCK 47K OHM X5 | 1 | RB 5 |
| R90-0521-05 | | RESISTOR BLOCK 47K OHM X7 | 1 | RB 6 |
| R90-0522-05 | | RESISTOR BLOCK 47K OHM X6 | 4 | RB 1, 2, 3, 4 |
| TC5065BP | | C.MOS IC INVERTER X6 | 4 | IC 1, 2, 3, 4 |
| 2SC2458(Y) | | TR | 1 | Q 1 |

## AT UNIT (X57-1130-00)

| PARTS NO. | NOTE | NAME & DESCRIPTION | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|
| CC45CH2H270J | | CERAMIC | 27P 500V | 1 | C 13 |
| CE04W0J101M | | ELECTRO | 100 6.3V | 2 | C 206,208 |
| CE04W1A101M | | ELECTRO | 100 10V | 1 | C 203 |
| CE04W1C100M | | ELECTRO | 10 16V | 4 | C 108,111,112,224 |
| CE04W1C101M | | ELECTRO | 100 16V | 3 | C 204,205,207 |
| CE04W1C470M | | ELECTRO | 47 16V | 1 | C 116 |
| CE04W1HR33M | | ELECTRO | 0.33 50V | 1 | C 217 |
| CE04W1H0R1M | | ELECTRO | 0.1 50V | 1 | C 220 |
| CE04W1H010M | | ELECTRO | 1 50V | 3 | C 114,212,216 |
| CE04W1H100M | | ELECTRO | 10 50V | 2 | C 1, 3 |
| CQ92FM1H103K | | MYLAR | 0.01 50V | 4 | C 210,215,219,222 |
| CQ92FM1H104K | | MYLAR | 0.1 50V | 1 | C 223 |
| CQ92FM1H473K | | MYLAR | 0.047 50V | 1 | C 218 |
| CQ92M1H333K | | MYLAR | 0.033 50V | 1 | C 214 |
| CQ92M1H473K | | MYLAR | 0.047 50V | 1 | C 115 |
| C02-0022-05 | | VARIABLE CAP. | 300P 1.2KV | 2 | VC 1, 2 |
| C05-0324-05 | | TRIMMER | 60P | 1 | TC 101 |
| C90-0840-05 | | ELECTRO | 10 16V | 1 | C 117 |
| C90-2015-05 | | ELECTRO | 330 25V | 1 | C 209 |
| C91-0456-05 | | CERAMIC | 0.047 25V | 2 | C 12,107 |
| | | | | 2 | 105,119 |
| DTC114ES | | DIGITAL TR | NPN | 1 | Q 7 |
| DTC124ES | | DIGITAL TR | NPN | 12 | Q 9, 10, 11, 12, 13,116,122,124,125,126 202,203 |
| D40-0623-25 | | MECHANISM ASS'Y | 1/200 | | |
| D40-0624-25 | | MECHANISM ASS'Y | 1/300 | | |
| D40-0625-15 | | MECHANISM ASS'Y | | 1 | |
| E04-0157-05 | * | RF COAX. CABLE RECEPTACLE | | 3 | |
| E40-0273-05 | * | MINI CONNECTOR | 2P | 6 | |
| E40-0373-05 | * | MINI CONNECTOR | 3P | 3 | |
| E40-0473-05 | * | MINI CONNECTOR | 4P | 5 | |
| E40-0573-05 | * | MINI CONNECTOR | 5P | 3 | |
| F20-0078-05 | | INSULATING PLATE | | 1 | |
| F29-0014-05 | | INSULATING WASHER :TRANSISTOR | | 1 | |
| HD10116 | | ECL IC | DIFF' AMP X3 | 1 | IC 101 |
| HD10125 | | ECL IC | LEVEL CONVT X4 | 1 | IC 103 |
| HD10131 | | ECL IC | D FLIP-FLOP X2 | 1 | IC 102 |
| J31-0502-04 | * | COLLAR | PC BOAD | 8 | |
| J42-0428-05 | * | BUSHING | PC BOAD | 8 | |
| LT8001P | | LED | RED | 4 | D 119,201,202,210 |
| L34-2250-05 | N | TUNING COIL A | | 1 | L 1 |
| L34-2251-05 | N | TUNING COIL B | | 1 | L 2 |
| L34-2252-05 | N | TUNING COIL C | | 1 | L 3 |
| L34-2253-05 | N | TUNING COIL D | | 1 | L 4 |
| L39-0415-15 | | DETECTOR COIL A | | 1 | L 102 |
| L39-0416-05 | | DETECTOR COIL B | | 1 | L 103 |
| L40-1011-04 | | INDUCTOR | 100 UH | 1 | L 5 |
| L40-1011-12 | | INDUCTOR | 100 UH | 9 | L 103,104,105,109,110,201,202,203,204 |
| L40-1011-13 | | INDUCTOR | 100 UH | 1 | L 106 |
| L40-1011-14 | | INDUCTOR | 100 UH | 2 | L 107,108 |

| PARTS NO. | NOTE | NAME & DESCRIPTION | | QTY | REFERENCE NO. |
|---|---|---|---|---|---|
| MC10116L | | ECL IC | DEFF' AMP X3 | 1 | IC 101 |
| MC10125L | | ECL IC | LEVEL CONVT X4 | 1 | IC 103 |
| MC10131L | | ECL IC | D FLIP-FLOP X2 | 1 | IC 102 |
| MC14077BCP | | C.MOS IC | 2INP' EX-NOR X4 | 1 | IC 208 |
| MTZ10J(A,B) | | ZENER DIODE | 10 V | 5 | D 11, 12, 13, 14,207 |
| MTZ11JC | | ZENER DIODE | 11 V | 1 | D 211 |
| MTZ16J(A,B) | | ZENER DIODE | 16 V | 1 | D 27 |
| MTZ20J | | ZENER DIODE | 20 V | 1 | D 115 |
| MTZ5.6JB | | ZENER DIODE | 5.6V | 1 | D 10 |
| NE555P | | TIMER IC | | 1 | IC 106 |
| NE556N | N | TIMER IC | DUAL | 1 | IC 204 |
| NJM2901 | | LINER IC | QUADRUPLE | 1 | IC 104 |
| NJM2904D | | LINER IC | DUAL | 1 | IC 105 |
| N10-2030-46 | | NUT,TR | M3 | 2 | |
| RC05GF2H101J | | RES. SOLID | 100 OHM 1/2W | 2 | R 101,102 |
| RC05GF2H821J | | RES. SOLID | 820 OHM 1/2W | 1 | R 9 |
| RS14GB3D330J | | METAL FILM | 33 OHM 2W | 3 | R 221,222,223 |
| R12-2410-05 | | TRIM.POT. | 5K OHM | 1 | VR 102 |
| R12-3434-05 | | TRIM.POT. | 10K OHM | 1 | VR 101 |
| R90-0515-05 | | RESISTOR BLOCK | 10K OHM X4 | 1 | RB 1 |
| R90-0560-05 | | CAP.BLOCK | 0.022 X5 | 1 | IB 1 |
| R90-0561-05 | | RESISTOR BLOCK | 22K OHM X6 | 1 | RB 2 |
| R90-0570-05 | | DIODE BLOCK | | 2 | IB 101,102 |
| R90-0592-05 | N | RESISTOR BLOCK | 4.7KOHM X6 | 1 | RB 3 |
| SN74LS145N | | TTL IC: BCD | DECIMAL DECODER | 1 | IC 1 |
| S51-1424-05 | | RELAY | DS-1 24V | 7 | RL 1, 2, 3, 4, 5, 5, 6, 8 |
| S51-2411-05 | | RELAY | 321D024 | 1 | RL 101 |
| S51-2414-05 | | RELAY | FBR244D012 | 1 | RL 7 |
| TC4001BP | | C.MOS IC | | 1 | IC 207 |
| TC4011BP | | C.MOS IC | 2-INPUT NAND X4 | 1 | IC 206 |
| TC4027BP | | C.MOS IC | JK FLIP-FLOP X2 | 1 | IC 205 |
| T42-0303-05 | | MOTOR | | 2 | M 1, 2 |
| UPC78L08A | | AVR IC | 8 V | 1 | IC 202 |
| UPC7805H | | AVR IC | 5 V | 1 | IC 201 |
| UPC7812H | | AVR IC | 12V | 1 | IC 203 |
| 1N4448 | | DIODE | | 9 | D 1, 2, 3, 4, 5, 6, 7, 8,112 |
| 1N60 | | DIODE | | 2 | D 101,102 |
| 1SS133 | | DIODE | | 29 | D 9, 15, 16, 17, 18, 19, 20, 21, 22, 23 24, 25, 26,107,108,109,110,111,113,114 116,117,118,203,204,205,206,208,209 |
| 1SS99 | | DIODE | | 4 | D 103,104,105,106 |
| 1S1555 | | DIODE | | | D 1, 2, 3, 4, 5, 6, 7, 8,112 |
| 2SA1015(Y) | | TR | | 7 | Q 1, 2, 3, 4, 5, 6,201 |
| 2SA1048(Y) | | TR | | 3 | Q 101,102,123 |
| 2SA950(Y) | | TR | | 4 | Q 103,108,110,115 |
| 2SA966(O) | | TR | | 1 | Q 118 |
| 2SA984K(E) | | TR | | 1 | Q 119 |
| 2SC2120(Y) | | TR | | 4 | Q 105,106,112,113 |
| 2SC2458(Y) | | TR | | 8 | Q 104,107,109,111,114,117,120,121 |

## KEYBOARD ASS'Y (S59-0433-15)

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| E40-0373-05 | | MINI CONNECTOR 3P | 2 | |
| E40-0473-05 | | MINI CONNECTOR 4P | 2 | |
| E40-0573-05 | | MINI CONNECTOR 5P | 3 | |
| E40-0673-05 | | MINI CONNECTOR 6P | 1 | |
| E40-0773-05 | | MINI CONNECTOR 7P | 2 | |
| E40-0873-05 | | MINI CONNECTOR 8P | 1 | |
| LN01201C | | LED RED | 3 | D 39, 46, 48 |
| LN01301C | | LED GREEN | 6 | D 37, 40, 41, 42, 45, 47 |
| LN01401C | | LED UMBER | 5 | D 38, 43, 44, 49, 50 |

## LCD ASS'Y (W02-0368-05)

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| B11-0427-08 | N | REFLECTOR | 1 | |
| B11-0428-08 | N | LIGHT GUIDING PLATE | 1 | |
| B30-0835-08 | N | LAMP | 2 | |
| E29-0461-08 | N | LCD CONNECTOR | 2 | |
| E31-3099-08 | N | CONNECTOR WITH WIRE 2P | 1 | |
| E31-3100-08 | N | INSIDE CONNECTING WIRE 10P | 1 | |
| FTD-7155 | N | LCD | 1 | |
| HD44100 | N | C.MOS IC LCD DRIVER | 1 | IC 2 |
| HD44780 | N | C.MOS IC LCD DRIVER | 1 | IC 1 |
| J19-1416-08 | N | LCD HOLDER | 1 | |
| RD73EB2B222J | | CHIP RESISTOR 2.2KOHM 1/8W | 5 | R 1, 2, 3, 4, 5 |
| RD73EB2B913J | | CHIP RESISTOR 91K OHM 1/8W | 1 | R 6 |

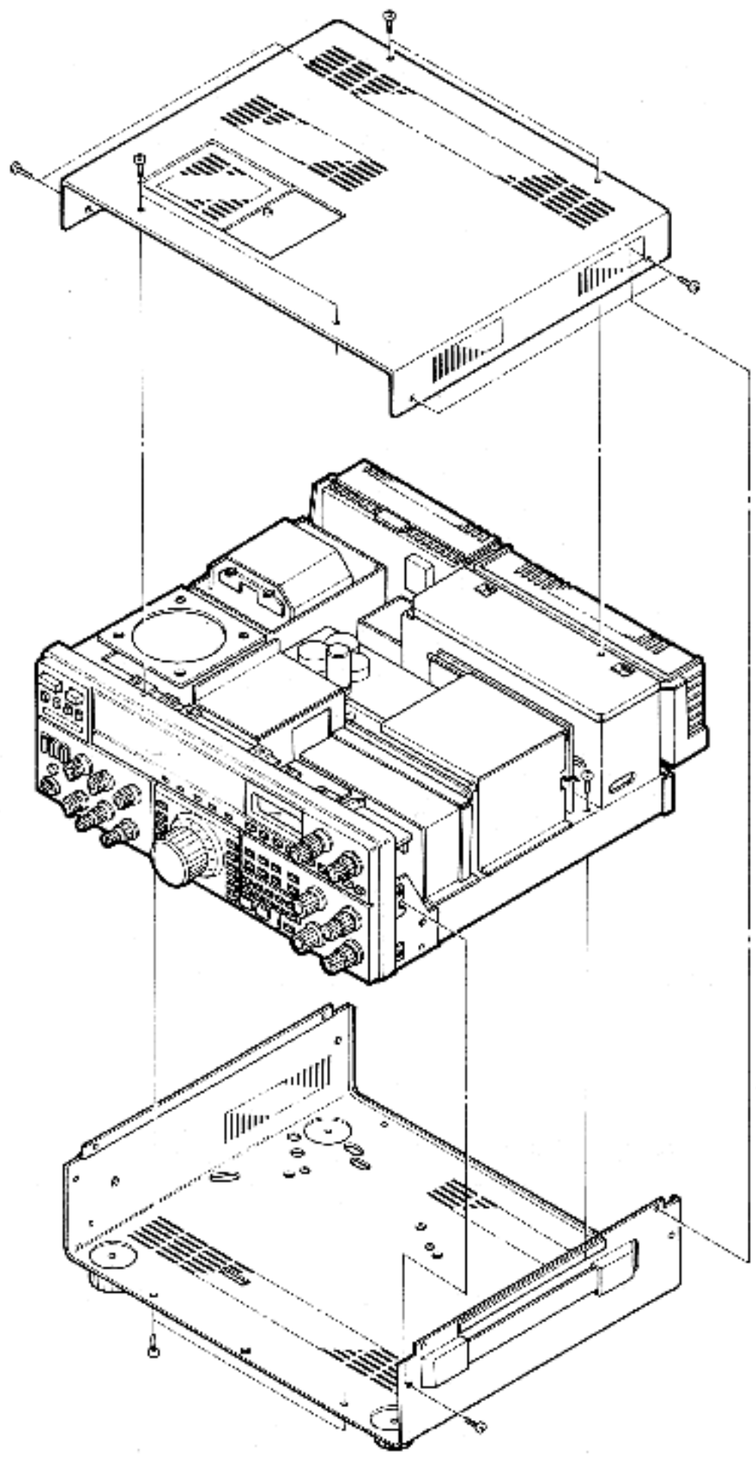
## MAIN ENCODER ASS'Y (W02-0328-10)

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| CE04W1A470M | | ELECTRO 47 10V | 1 | C 1 |
| E40-0474-05 | | MINI CONNECTOR 4P L TYPE | 1 | |
| LM358P | | LINEAR IC DUAL | 1 | IC 1 |
| LN66(S) | | DIODE | 2 | D 1, 2 |
| PN126S | | PHOTO TRANSISTOR | 2 | Q 2, 3 |
| R12-2411-05 | | TRIM.POT. 5K OHM | 2 | VR 1, 2 |
| 2SA1015(Y) | | TR | 1 | Q 1 |
| 25D29 | | THERMISTOR 500 OHM | 1 | TH 1 |

# TS-940S DISASSEMBLY

**Disassembly and assembly for upper and bottom case**

1) When removing the top and bottom case take round head screws, eight from upper case and nine from bottom case, cautions on removing case from scratches slightly shift the case to rear side.
2) When assemble the case take back words process of disassembly with pay attention for pinched wire between case and chassis.



**Disassembly and cautions for rear panel**

1) Take care not to damage terminals ANT and GND on the rear panel since they are soldered or screwed to the PC board.
2) When repairing the final seciton, remove the upper and lower cases, then the final heatsink and shield case for the Filter unit. (When repairing the Filter unit, remove the above parts, too.)

**Disassembly and cautions for internal mechanism**

1) Cautions on replacement of transformer
   Tighten the hexagon socket head bolts to torque of 20kg-cm. Check the transformer for shock, looseness, and correspondence.
2) Removing mounting hardware for electric capacitor. The mounting hardware for electric capacitor can be removed by removing four screws.
3) The speaker is installed to the mounting hardware on the chassis, different from the models in the past.

**Disassembly for front panel**

1) To incline the front panel, remove two flat screws from the mounting hardware which securing the chassis and panel, and loosen two round screws. The panel at chasssis side will incline more than 90°, and the parts at inside of the panel can be inspected and repaired easily.
2) Removing main knob
   If the dial ring fit to the rim of main knob is removed, the hexagon socket head bolt can be seen which is securing the main knob. The main knob can be removed by loosening this bolt.
3) When removing the KEY BOARD ASS'Y (MODE, FUNCTION, MEMORY, BAND KEY), remove the main encoder and eleven flat screws (M2.6 x 4)
4) When replacing the name plate on the display window for display and meter, push each end and two middle of the name plate from rear with a thin screw driver through the square hole on the panel.
5) When replacing the front glass, remove the name plate and two flat screws (M2 x 6)
6) When removing the display take from the mounting hardware, insert a thin screw driver, etc. into the mounting hardware at both sides. Remove the display tube with the screw driver from the projection of the mounting hardware for display tube.

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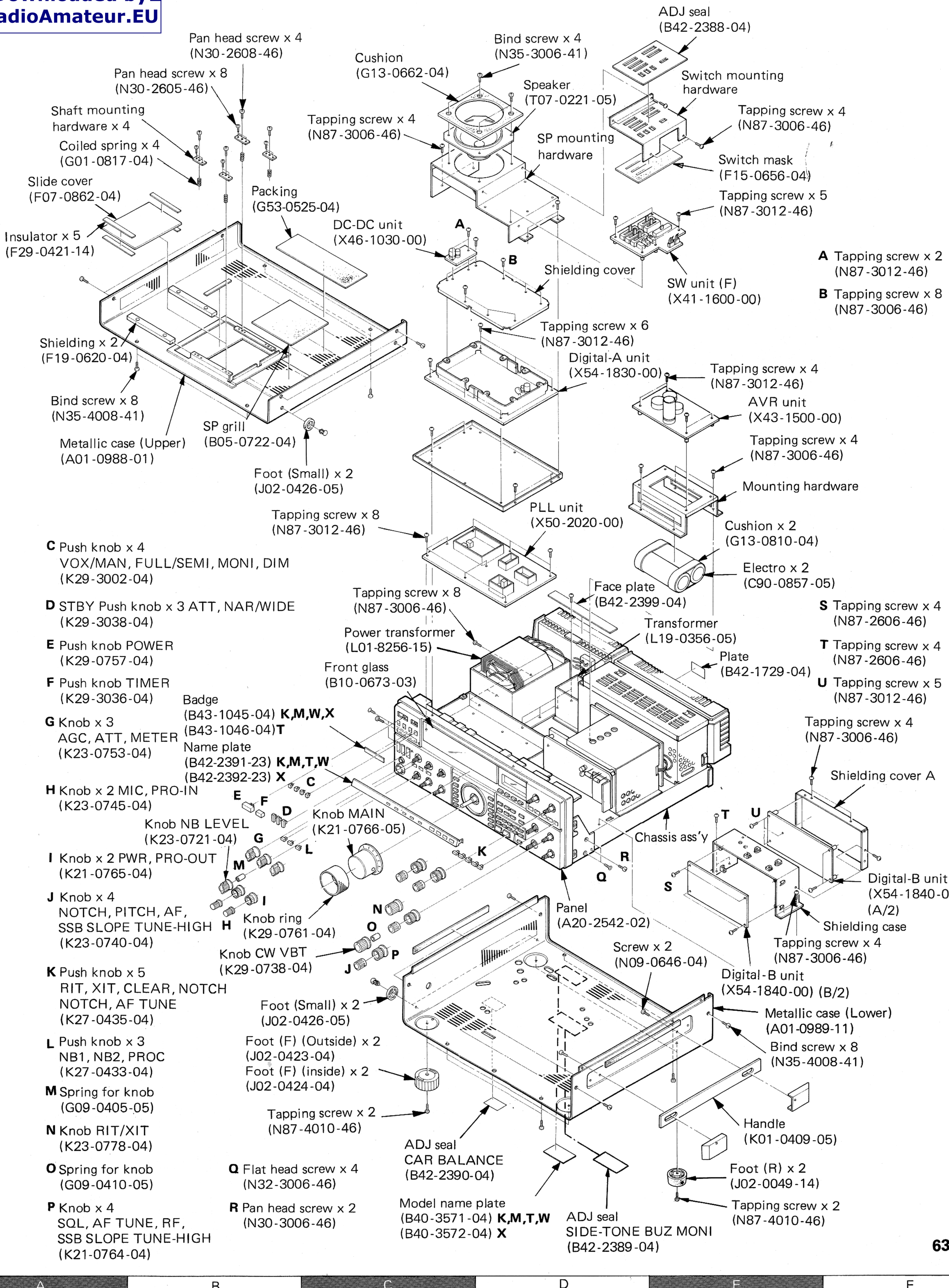



**A** Tapping screw x 2
(N87-3012-46)

**B** Tapping screw x 8
(N87-3006-46)

**C** Push knob x 4
VOX/MAN, FULL/SEMI, MONI, DIM
(K29-3002-04)

**D** STBY Push knob x 3 ATT, NAR/WIDE
(K29-3038-04)

**E** Push knob POWER
(K29-0757-04)

**F** Push knob TIMER
(K29-3036-04)

**G** Knob x 3
AGC, ATT, METER
(K23-0753-04)

**H** Knob x 2 MIC, PRO-IN
(K23-0745-04)

**I** Knob x 2 PWR, PRO-OUT
(K21-0765-04)

**J** Knob x 4
NOTCH, PITCH, AF,
SSB SLOPE TUNE-HIGH
(K23-0740-04)

**K** Push knob x 5
RIT, XIT, CLEAR, NOTCH
NOTCH, AF TUNE
(K27-0435-04)

**L** Push knob x 3
NB1, NB2, PROC
(K27-0433-04)

**M** Spring for knob
(G09-0405-05)

**N** Knob RIT/XIT
(K23-0778-04)

**O** Spring for knob
(G09-0410-05)

**P** Knob x 4
SQL, AF TUNE, RF,
SSB SLOPE TUNE-HIGH
(K21-0764-04)

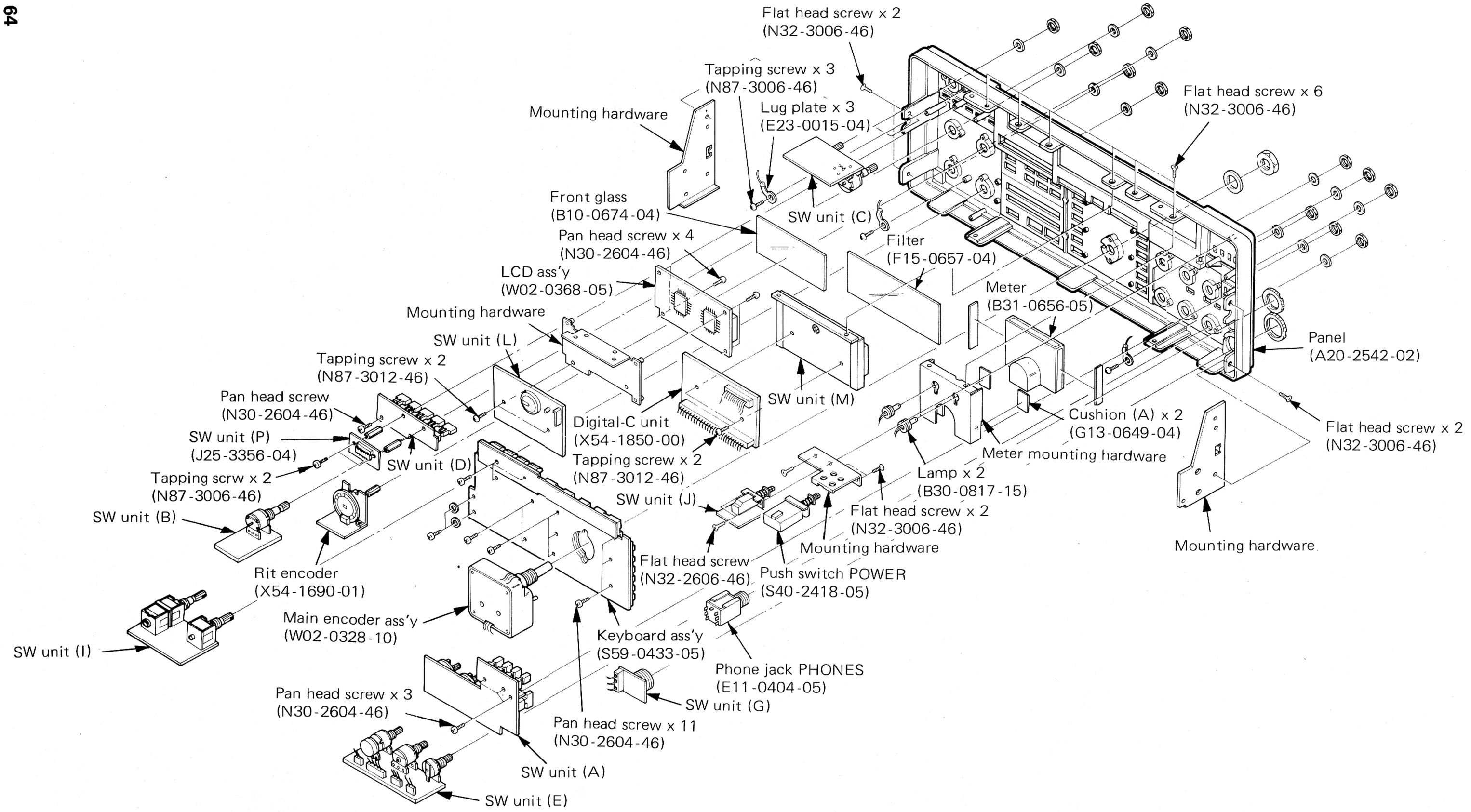
**Q** Flat head screw x 4
(N32-3006-46)

**R** Pan head screw x 2
(N30-3006-46)

**S** Tapping screw x 4
(N87-2606-46)

**T** Tapping screw x 4
(N87-2606-46)

**U** Tapping screw x 5
(N87-3012-46)




SW unit (X41-1600-00)

| | | | | |
|---|---|---|---|---|
| **A** | S4—10 | (S40-2440-15) | Push switch | VOX/MAN,FULL/SEMI,MONI,DIM,SEND/REC,AT·T,NAR/WIDE |
| | S11 | (S01-1432-05) | Rotary switch | ATT |
| | S12 | (S01-1431-05) | Rotary switch | AGC |
| | S13 | (S01-1430-05) | Rotary switch | METER |
| | S14—16 | (S40-2434-05) | Push switch | NB1, NB2, PROC |
| **B** | VR12 | (R19-3413-05) | Pot. | AF/RF |
| **C** | VR10 | (R19-3421-05) | Pot. | PITCH/AF TUNE |
| | VR11 | (R24-9402-05) | Pot. | NOTCH/SQL |
| **D** | S17—19 | (S40-2439-15) | Push switch | RIT, XIT, CLEAR |
| | S20, 21 | (S40-2438-15) | Push switch | NOTCH, AF TUNE |
| **E** | VR7 | (R01-0407-05) | Pot. | NB LEVEL |
| | VR8 | (R19-3422-05) | Pot. | PROC-IN/OUT |
| **G** | J2 | (E06-0858-05) | 8P metal socket | MIC |
| **I** | S2 | (S29-1434-05) | Rotary switch | CW VBT |
| | S3 | (S29-2410-05) | Rotary switch | SSB SLOPE TUNE-HIGH/LOW |
| **J** | S26 | (S40-2453-05) | Rotary switch | TIMER |
| **L** | S1 | (S50-1411-05) | Tact switch | |
| **M** | V1 | (11-BT-05Z) | Display tube | — |

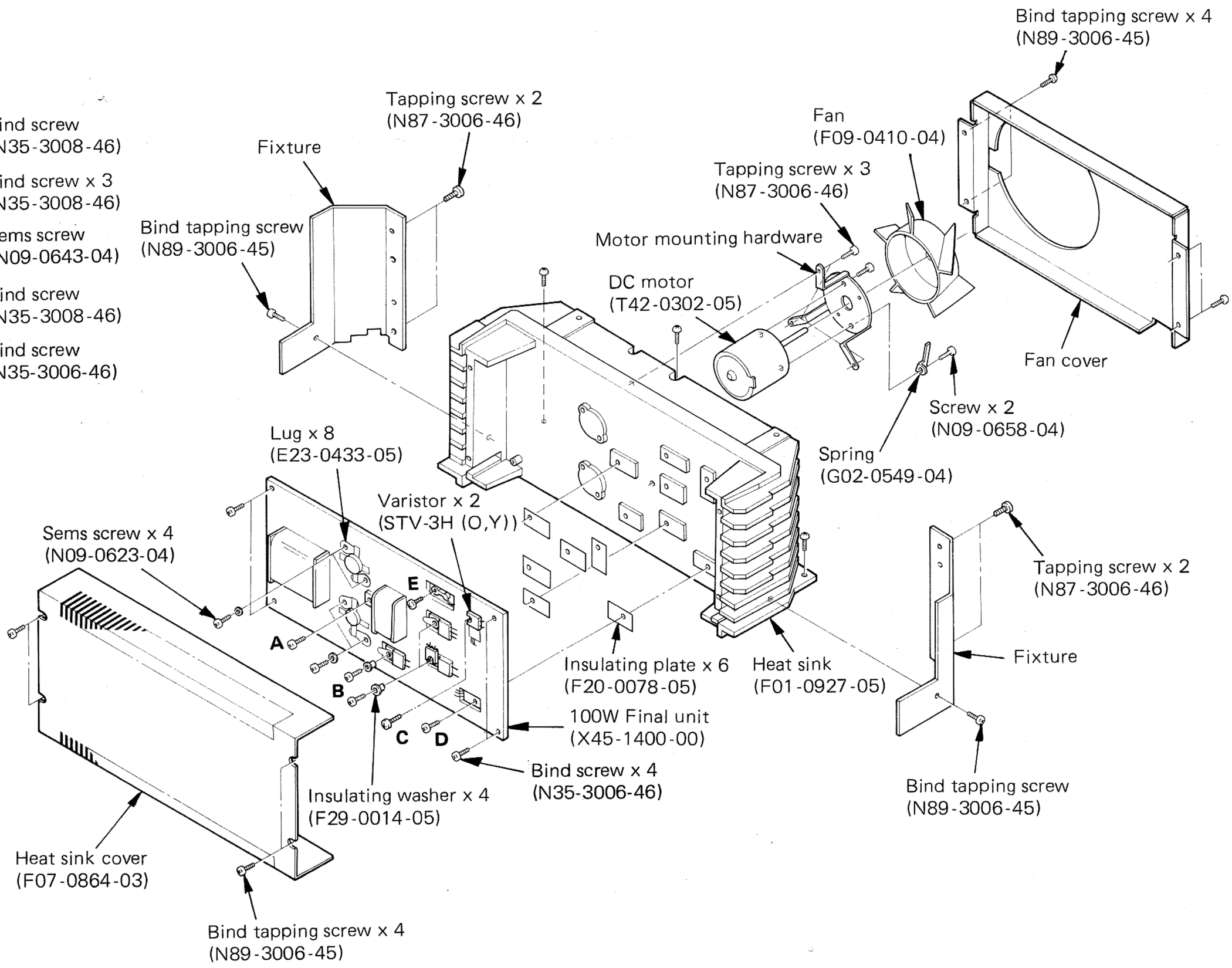
**A** Bind screw (N35-3008-46)

**B** Bind screw x 3 (N35-3008-46)

**C** Sems screw (N09-0643-04)

**D** Bind screw (N35-3008-46)

**E** Bind screw (N35-3006-46)




**A** Pan head screw x 2 (N30-2004-45)

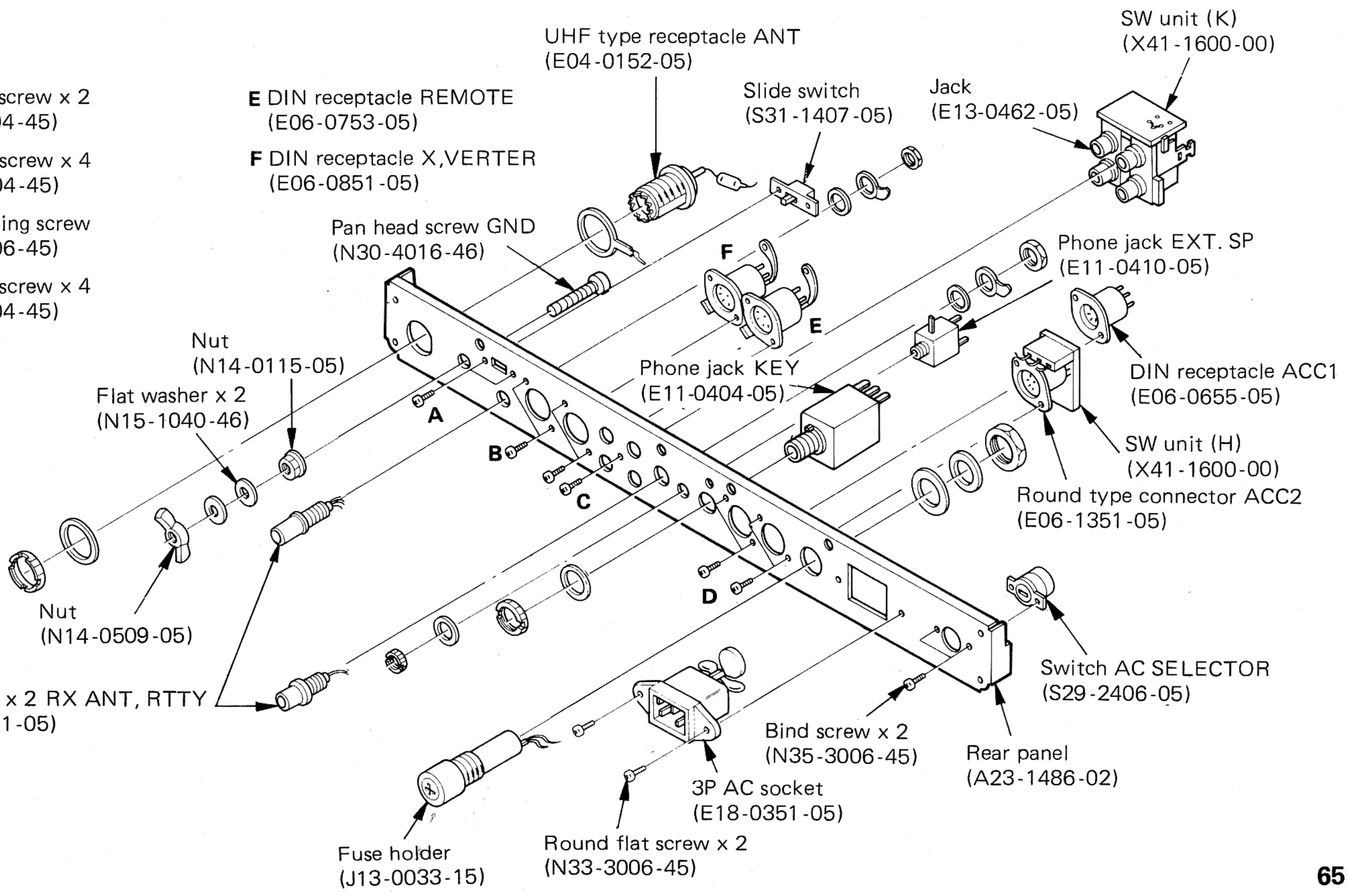
**B** Pan head screw x 4 (N30-2604-45)

**C** Bind tapping screw (N89-3006-45)

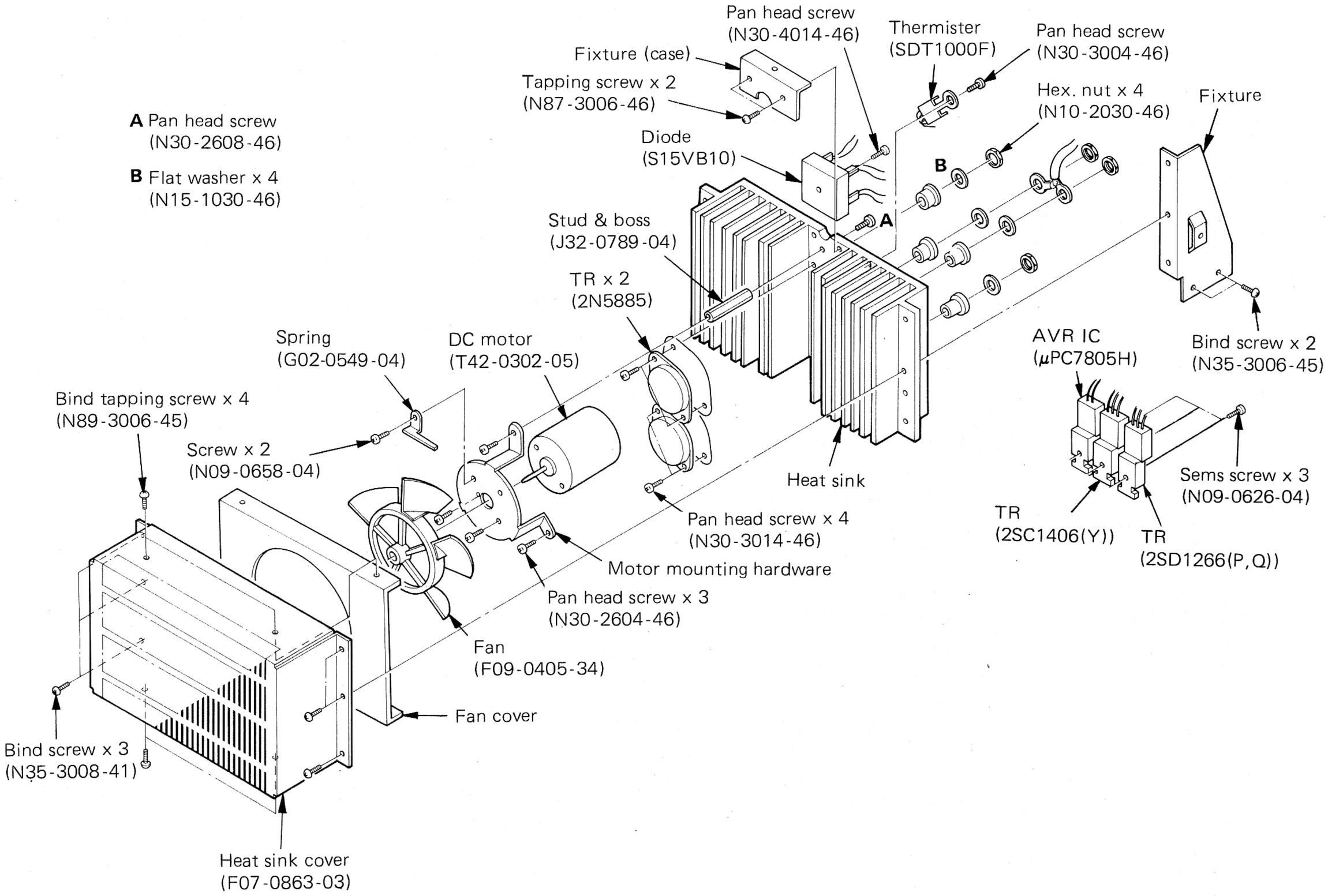
**D** Pan head screw x 4 (N30-2604-45)

**E** DIN receptacle REMOTE (E06-0753-05)

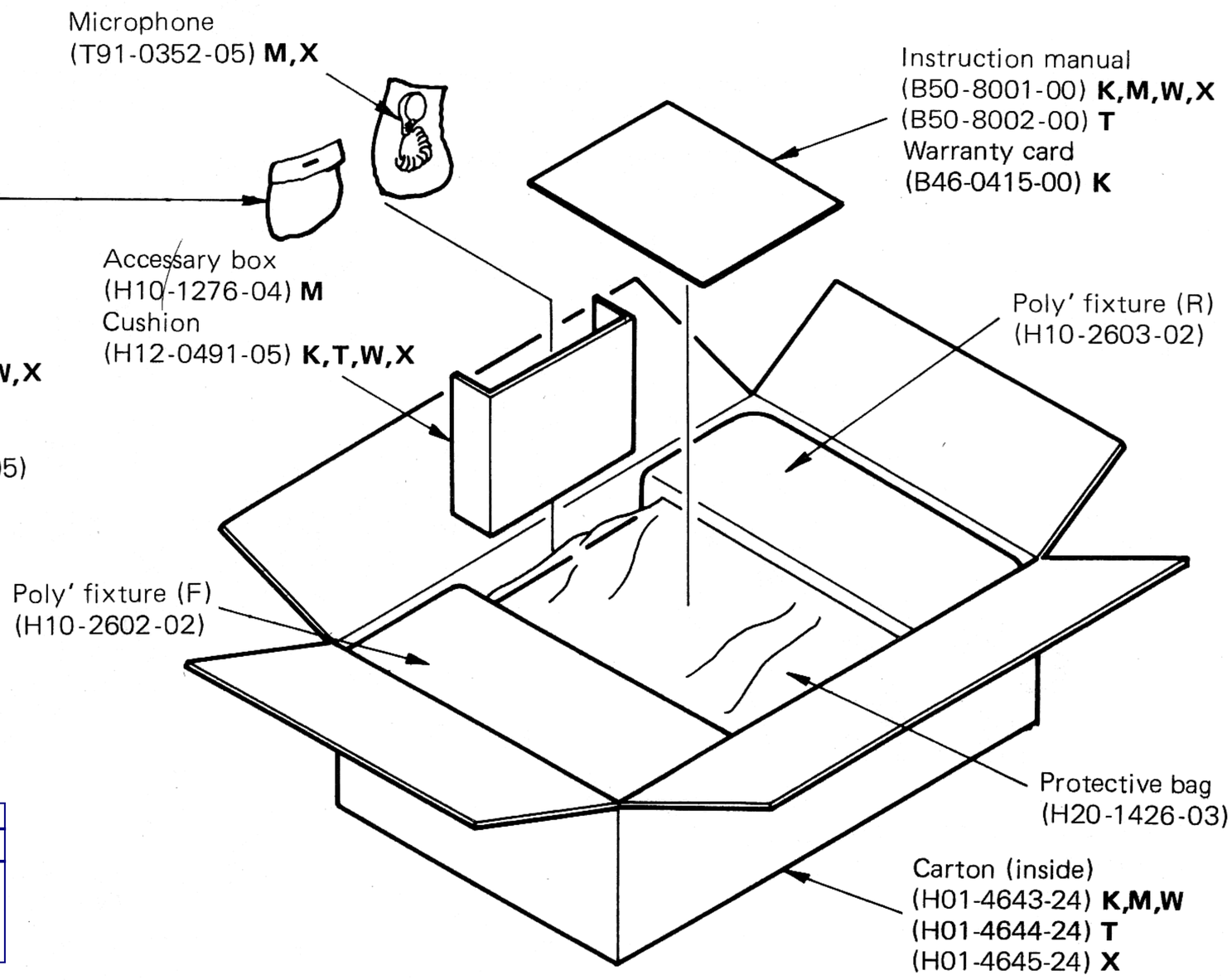
**F** DIN receptacle X,VERTER (E06-0851-05)



# TS-940S DISASSEMBLY/PACKING




## PACKING

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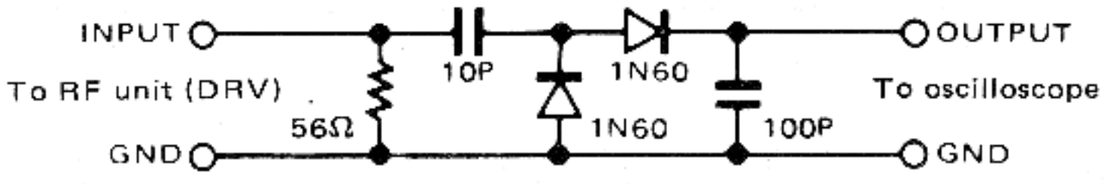
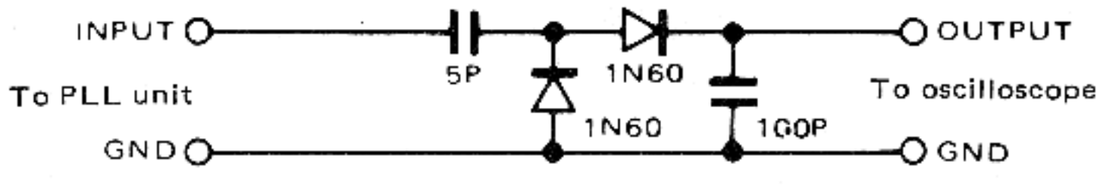
# ADJUSTMENT

## REQUIRED TEST EQUIPMENT

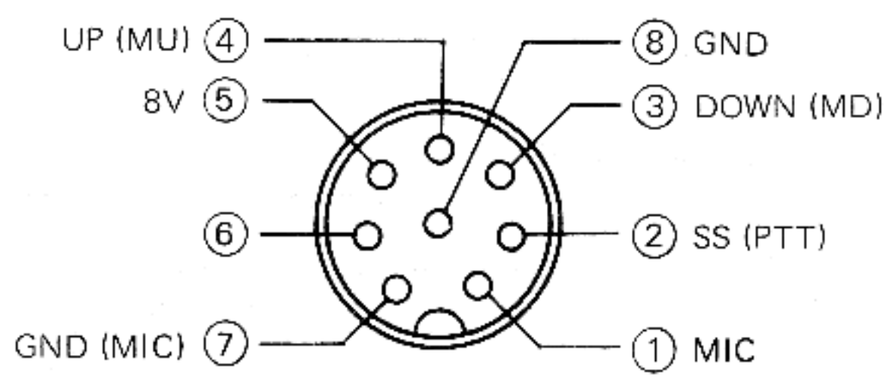
1. DC Voltmeter (DC V.M)
   1) Input resistance : More than 1MΩ
   2) Voltage range : 1.5 to 1000V AC/DC
   NOTE : A high-precision multimeter may be used. However, accurate readings can not be obtained for high-impedance circuits.
2. DC Ammeter
   1) Current range : 100mA, 1.5A, 15A, High-precision ammeter may be used.
3. RF VTVM (RF V.M)
   1) Input impedance : 1MΩ and less than 3pF, min.
   2) Voltage range : 10mV to 300V
   3) Frequency range : 10kHz to 100MHz or greater
4. AF Voltmeter (AF V.M)
   1) Frequency range : 50Hz to 10kHz
   2) Input resistance : 1MΩ or greater
   3) Voltage range : 10mV to 30V
5. AF Generator (AG)
   1) Frequency range : 200Hz to 5kHz
   2) Output : 1mV or less to 1V, low distortion
6. AF Dummy Load
   1) Impedance : 8Ω
   2) Dissipation : 3W or greater
7. Oscilloscope (SCOPE)
   Requires high sensitivity, and external synchronization capability.
8. Sweep Generator (SWEEP)
   1) Center frequency : 50kHz to 90MHz
   2) Frequency deviation : Maximum ±35MHz
   3) Output voltage : 0.1V or greater
   4) Sweep rate : At least 0.5sec/cm
9. Standard Signal Generator (SSG)
   1) Frequency range : 50kHz to 50MHz
   2) Output : −20dB/0.1μV to 120dB/1V
   3) Output impedance : 50Ω
   4) AM and FM modulation can be possible.
   NOTE : Generator must ve frequency stable.
10. Frequency Counter (FREQ.C)
    1) Minimum input voltage : 50mV
    2) Frequency range : 50MHz or greater
    3)
11. Noise Generator
    Must generate ignition noise containing harmonics beyond 30MHz.
12. RF Dummy Load
    1) Impedance : 150Ω and 20Ω
    2) Dissipation : 150W or greater
13. Power Meter
    1) Impedance : 50Ω
    2) Dissipation : 150W cintinuous or greater
    3) Frequency limits : 60MHz or greater
14. Spectrum Analyzer (SPE-ANA)
    1) Frequency range : 100kHz to 110MHz or greater
    2) Bandwidth : 1kHz to 3MHz
15. Detector
    1) For adjustment of TX BPF




    2) For adjustment of PLL/VCO BPF




16. Directional Coupler
17. Monitor Receiver
    R-1000 class
18. Microphone
    MC-60S8 or MC-42S




**MIC terminals (view from front panel side)**

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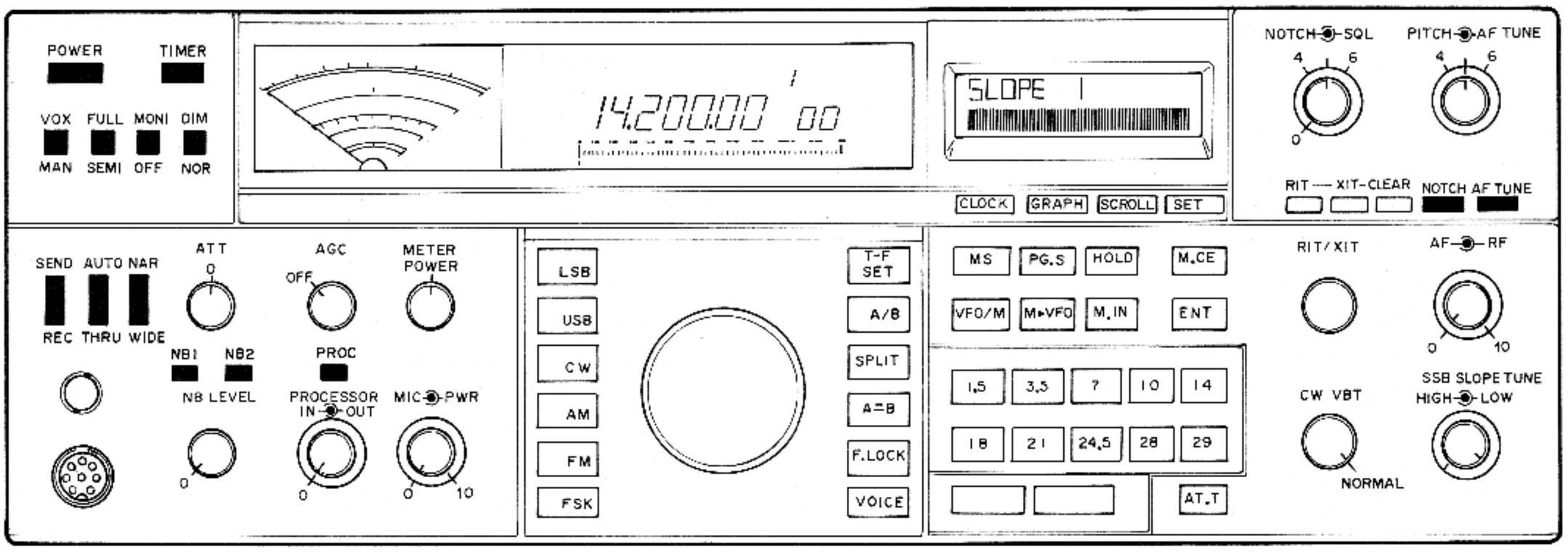
# ADJUSTMENT

## PREPARATION

Unless otherwise specified, set the controls as follows :

1. Power ON, holding A=B SW, keep ⊓⊔ condition from ⊓⊔ or ⊓⊔ SW's which marked ■ .
   (other push SW's are nonlock type or tact SW.)

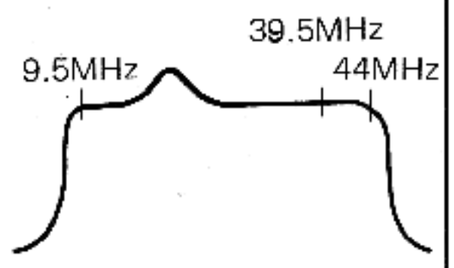
2. ATT . . . . . 0 NOTCH/SQL . . . . CENTER/0
   AGC . . . . . OFF PITCH/AF TUNE . . . CENTER
   METER . . . . . POWER AF/RF . . . . . 0/10
   NB LEVEL . . . . . 0 CW VBT . . . . . NORMAL
   PROCESSOR . . . . . 0 SSB SLOP TUNE
   MIC/PWR . . . . . 0/10 HIGH/LOW . . . CW/CCW, MAX



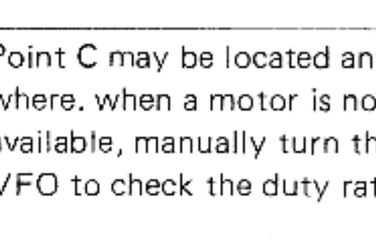
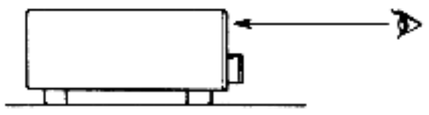
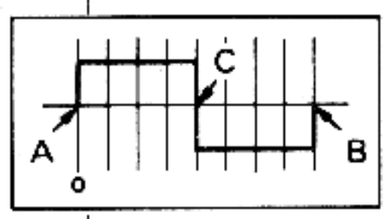
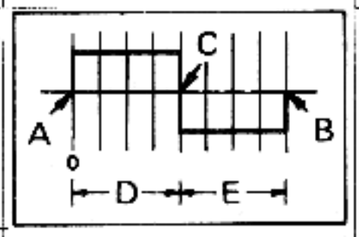

## VOLTAGE ADJUSTMENT AND CONFIGURATION

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test-equipment | Unit | Terminal | Unit | Part | Method | |
| 1. Voltage adjustment and confirmation | 1) POWER SW : ON<br>STBY : REC<br>MODE : CW<br>WIDE/NAR : NAR | DC V.M | AVR | FB | AVR | VR1 | ADJ to 28.5V | 28.5V±0.5V |
| | | | IF | RV ⑬ -2 | | | Confirm | 14.0—16.0V |
| | | | | RB ⑩ -5 | CONT | VR1 | ADJ to 2.1V | 2.1V±0.01V |
| | | | RF | AGC ④ -2 | IF | VR5 | ADJ to 3.2V | 3.2V±0.01V |
| | | | IF | W31 | | | Confirm | About 14V |
| | | | | W22 | | | | About 12V |
| | | | | W21 | | | | About 11V |

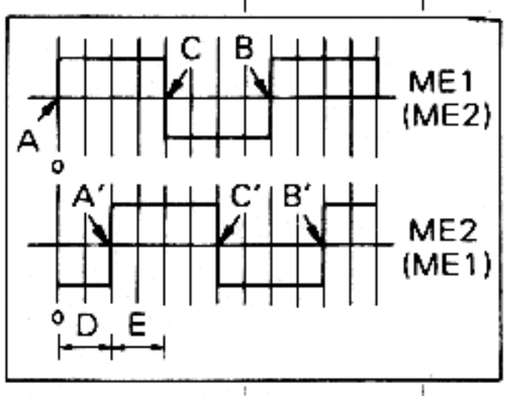
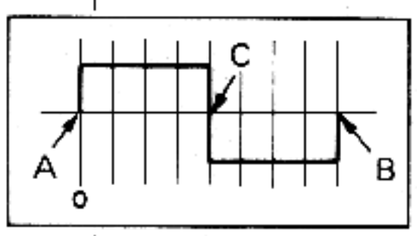
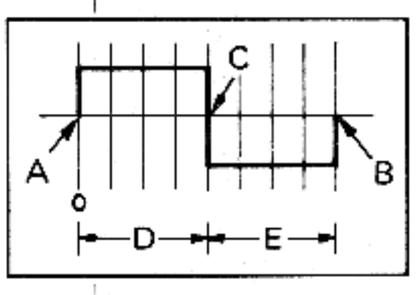
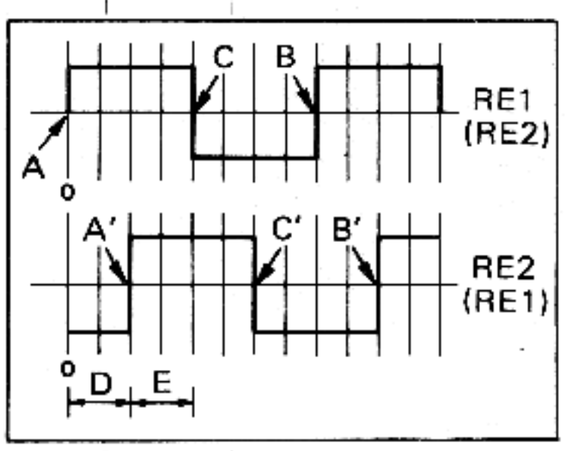
## CONTROL ADJUSTMENT

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 1. PLL-BPF | 1) POWER SW : ON<br>STBY : REC<br>MODE : CW<br>WIDE/NAR : NAR | SWEEP Detector SCOPE | PLL | TP4<br>TP5 | PLL | L25—27 | ADJ as shown at right. |  |
| 2. PLL-1 100—110 MHz | | RF V.M FREQ. C | PLL | TP1 | PLL | L10 | ADJ to 8V at 110MHz. | 110MHz : 8V<br>100MHz : 3.5—4.5V |

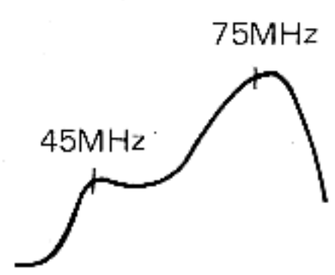
# ADJUSTMENT

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 3. PLL-2 35.5–40.5 MHz | 1) POWER SW : ON<br>STBY : REC<br>MODE : CW<br>WIDE/NAR : NAR | RF V.M<br>FREQ. C | PLL | TP3 | PLL | L5–6<br><br>L7 | ADJ L5 and L6 for MAX.<br>ADJ to 8V at 40.399.00MHz. | 40.399.00MHz : 8V<br>35.499.00MHz : 3.5–4.5V |
| 4. PLL-IF | | RF V.M<br>FREQ. C | PLL | TP5 | PLL | L17, 18, 20–24 | ADJ to MAX. | 100–170mV |
| 5. Standard oscillator adjustment and the marker check | 1) CAL : ON<br>BAND : 20.000.00MHz | SSG<br>SCOPE | PLL | ⑧-1 | PLL | TC1 | Receive the 10MHz and make the zero beet waveform as shown at right. (HET : 36.220.000 MHz) | Waveform on scope<br>  |
| 6. Adjustment of TX control voltage | 1) Display : 14.600.00 | DC V.M | IF | TV ⑬-1 | | | Confirm | Under –0.5V. |
| | 2) STBY : SEND | | | | | | Confirm | 14.0–16.0V |
| | 3) STBY : REC after ADJ. | | IF | ALC ⑥-1 | CONT | VR3 | ADJ to 3.2V | 3.20V±0.01V |
| 7. LCD Contrast | | | LCD | | SW | VR13 | Confirm LCD letters can see from as shown at right. | LCD control changes.<br>  |
| 8. VCO Adjustment | 1) VCO1<br>Display : 9.499.99MHz | DC V.M | RF | VC1 ⑨-4 | RF | L65 | ADJ to 12V and confirm the VC1 voltage changes from about 2.5V to 4.0V with the display frequency from 30kHz to 9.5MHz and VC2 voltage changes also with the display from 20MHz to 29.5MHz. | 12.00V±0.01V |
| | 2) VCO2<br>Display : 19.499.99MHz | | | | | L68 | | 12.00V±0.01V |
| | 3) VCO3<br>Display : 30.000.00MHz | | | VC2 ⑨-2 | | L71 | | 12.00V±0.01V |
| 9. Main encoder | 1) Remove the VFO knob and motor-drive the encoder at approx. 300rpm. | SCOPE | Digital B | Connector ①ME 1–2 | | |  | Point C may be located anywhere. when a motor is not available, manually turn the VFO to check the duty ratio. |
| | 2) ME1 duty ratio adjustment : Turn a motor CW and CCW | | | | Main encoder | VR1 |  | After adjusting with the VFO control tuned CW, check that intervals D and E are also identical when the VFO control is turned CCW. |
| | 3) ME2 duty ratio adjustment : Turn a motor in the both direction. | | | Connector ①ME 2–3 | | VR2 | Adjust until intervals D and E are equal to each other with point C placed at the center. | |

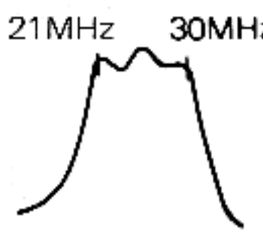
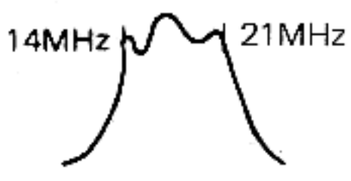
# ADJUSTMENT

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 9. Main encoder | 4) ME1, ME2 phase difference alignement : Same as above.   | SCOPE | Digital B | Connector ⑪ ME1, ME2 | Main encoder | Phase adjustment screw | Adjust until intervals D and E are equal to each other (point A' on ME2 is located in the middle of points A and C on ME1.) | ME1 (ME2) : Within 90° ± 10% (The difference between CW and CCW rotation must also be within this specification.) The phases of ME1 and ME2 may be replaced with each other,as indicated in the brackets. |
| 10. RIT encoder | 1) Remove the RIT knob and motor-drive the encoder at approx. 300rpm. | SCOPE | Digital B | Connector ⑫ RE1–3 | |   | | Point C may be located anywhere. When a motor is not available, manually turn the RIT to check the duty ratio. |
| | 2) RE1 duty ratio adjustment : Turn a motor CW and CCW | | | | RIT encoder | VR1   | | After adjusting with the RIT control tuned CW, check that intervals D and E are also identical when the RIT control is turned CCW. |
| | 3) RE2 duty ratio adjustment : Turn a motor in the both direction | | | Connector ⑫ RE2–2 | | VR2 | Adjust until intervals D and E are equal to each other with point C placed at the center. | |
| | 4) RE1, RE2 phase difference alignment : Same as above. | | | Connector ⑫ RE1, RE2 | |   | | The phases of RE1 and RE2 may be replaced with each other as indicated in the brackets. |
| 11. CAR1 adjustment | 1) MODE : USB | FREQ. C DC V.M | IF | CR1 ⑱ -2 | CAR | TC1 | ADJ to 453.50kHz | 453.50kHz±50Hz |
| | | | CAR | TP1 | | L6 | ADJ to 7.0V | 7.00±0.04V |
| | 2) STBY : SEND | | IF | CR1 ⑱ -2 | | | Confirm | Same frequency as REC. |
| | 3) STBY : REC MODE : LSB | | | | | TC2 | ADJ to 456.50kHz | 456.50kHz±50Hz |

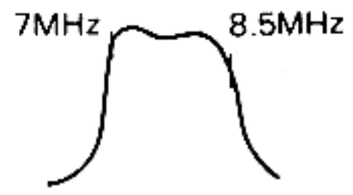
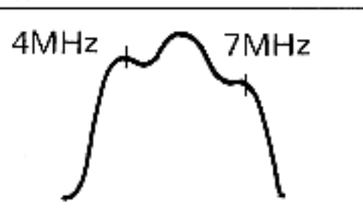
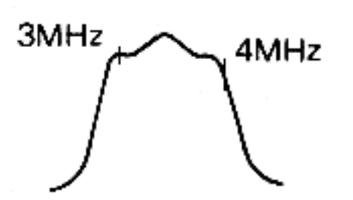
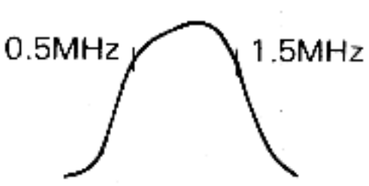
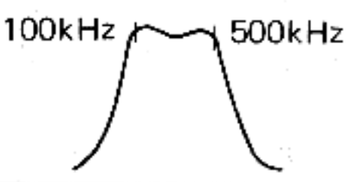
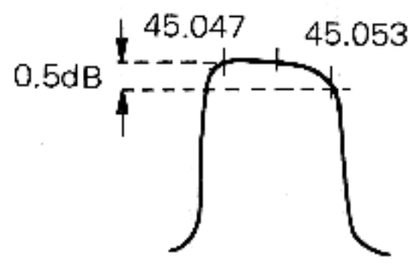
# ADJUSTMENT

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 11. CAR1 adjustment | 4) STBY : SEND | FREQ. C<br>DC V.M | IF | CR1<br>⑱ -2 | CAR | | Confirm | Same frequency as REC. |
| | 5) MODE : CW<br>WIDE/NAR : WIDE<br>STBY : REC | | | | | | Confirm at REC & SEND | 454.30kHz±50Hz |
| | 6) WIDE/NAR : NAR | | | | | | Confirm green LED light on. | |
| | 7) MODE : AM | | | | | | | 455.00kHz±50Hz |
| | 8) MODE : FM | | | | | | | |
| | 9) MODE : FSK<br>WIDE/NAR : WIDE | FREQ. C | IF | CR1<br>⑱ -2 | CAR | | Confirm | 457.20kHz±50Hz |
| 12. CAR2 Adjustment | 1) MODE : CW | | IF | W25 | CAR | TC3 | ADJ to 9.285.0MHz | 9.285.00±50Hz<br>(0.3Vrms) |
| | | | CAR | TP2 | | L10 | ADJ to 7.0V | 7.00V±0.04V |
| | 2) STBY : SEND | | IF | W25 | | | Confirm | Same frequency as REC. |
| 13. CAR3 Adjustment and confirmation | 1) MODE : CW | | CONT | CR3<br>㉟ -4 | IF | L20 | ADJ to 100.0kHz | 100.0kHz±20Hz |
| | 2) MODE : USB<br>: LSB<br>: AM<br>: FM<br>: FSK | | | | | | Confirm | USB : 98.5kHz±250Hz<br>LSB : 101.5kHz±200Hz<br>AM : 100.0kHz±100Hz<br>FM : 100.0kHz±100Hz<br>FSK : 101.5kHz±200Hz |
| 14. CAR4 Adjustment | 1) MODE : CW | FREQ. C | CONT | CR4<br>㉟ -1 | IF | L19 | ADJ to 99.20kHz | 99.20kHz±20Hz |
| | 2) CW PITCH : MAX | RF V.M | IF | Q14<br>(E) | | L18 | ADJ to MAX. | About 0.3Vrms. |
| 15. CAR AMP | 1) | RF V.M | CAR | PLUG<br>② -4 | CAR | L19<br>L20 | ADJ to MAX. | (REF. 100mV±50mV) |
| 16. VCO BPF | | SWEEP<br>SCOPE<br>Detector | RF | Q17-G<br>Q21-E | RF | L74<br>–76 | ADJ as shown at right. |  |

## RX ADJUSTMENT

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 1. 0.1–30MHz BPF | 1) BAND : 20.0–30.0MHz<br>FREQ : 29.500.0kHz<br>RF ATT : 0dB<br>STBY : REC<br>Disconnect RF unit, RIF connector, and connect this plug to detector. | SWEEP<br>Detector<br>SCOPE | Body<br><br>RF | ANT<br><br>RIF | RF | L2,<br>L31–<br>33,40,<br>44 | Adjust as shown at right. |  |
| | 2) BAND : 14.0–20.0MHz<br>FREQ : 18.000.0kHz | | | | | L28–<br>30 | |  |
| | 3) BAND : 8.5–14.0MHz<br>FREQ : 10.000.0kHz | | | | | L25–<br>27 | | |

# ADJUSTMENT

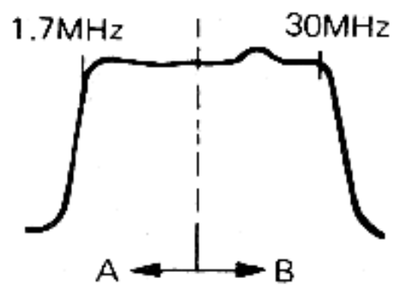
| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 1. 0.1–30MHz BPF | 4) BAND : 7.0–8.5MHz<br>FREQ : 7.000.0kHz | SWEEP<br>Detector<br>SCOPE | Body<br>RF | ANT<br>RIF | RF | L22–24 | Adjust as shown at right. |  |
| | 5) BAND : 4.0–7.0MHz<br>FREQ : 6.900.0kHz | | | | | L18–21 | |  |
| | 6) BAND : 3.0–4.0MHz<br>FREQ : 3.900.0kHz | | | | | L14–16 | |  |
| | 7) BAND : 1.5–3.0MHz<br>FREQ : 1.900.0kHz | SWEEP<br>Detector<br>SCOPE | Body<br>RF | ANT<br>RIF | RF | L11–13 | Adjust as shown at right. | |
| | 8) BAND : 0.5–1.5MHz<br>FREQ : 1.000.0kHz | | | | | L9, 10 | |  |
| | 9) BAND : 100–500kHz<br>DISPLAY : 300.0kHz | | | | | L5–7 | |  |
| 2. MCF | 1) BAND : 14.250MHz<br>MODE : CW | SWEEP<br><br>SPE-<br>ANA | RF<br><br>IF | TP1<br><br>TP1 | RF<br><br>IF | L44–46<br><br>L3–5 | ADJ to MAX as shown at right.<br>Center frequency 45.050MHz |  |
| 3. RX IF AMP | 1) MODE : CW<br>BAND : 14.175MHz<br>VR1 on RF unit : Center<br>AF VR : As desire | SSG<br>AF V.M<br>SP<br>SCOPE | | EXT. SP | RF<br><br>IF | VR2<br>L44–46<br><br>L7–15,17, 23–25 | VR2 ADJ to center and other L's ADJ to MAX AF output.<br>**Note** : Repeat ADJ L7–10 and 23–25. | |
| | 2) SSG : 15dB | DC V.M | CONT | TP1 (R153) | CONT | L2,3 | ADJ to MIN | |
| 4. NOTCH | 1) NOTCH VR : Center<br>SSG : 0dB | SSG<br>AF V.M<br>SP<br>SCOPE | | | | | ADJ the AV VR to 800Hz/0.63V. | |
| | 2) NOTCH SW : ON<br>SSG : 40dB | | | | IF | L16<br>VR2 | Repeat ADJ for MIN AF output. | Dip point should be in between 11–1 o'clock position. |
| 5. IF TRAP Coil | BAND : 1.400MHz<br>SSG : 45.05MHz<br>80dB | | | | RF | L2<br><br>L40 | Set the core all the way inside.<br><br>ADJ for MIN AF output. | |
| 6. S meter | BAND : 14.175MHz<br>SSG : 0dB | SSG<br>AF V.M<br>SP<br>SCOPE | | | IF<br><br>RF | VR3<br><br>VR1 | ADJ meter needle for mechanical $\phi$ point.<br><br>Set the VR1 to CCW. | |

# ADJUSTMENT

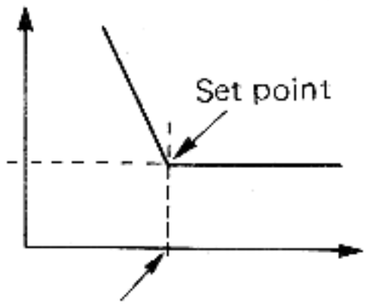
| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 6. S meter | SSG : 8dB<br>AGC : FAST | | | | IF | VR1 | ADJ to S1 | S1 : 8dB +6dB<br>−4dB |
| | SSG : 40dB | | | | | VR4 | ADJ to S9 | S9 : 40dB±6dB |
| | | | | | | | Repeat ADJ S1 and S9. | S9 + 60dB : 100dB±10dB |
| 7. ATT Confirmation | BAND : 14.175MHz | SSG<br>AF V.M<br>SP | | | PAN-EL | ATT | ATT : SSG<br>10dB 50dB<br>20dB 60dB<br>30dB 70dB | <br>10dB±3dB<br>20dB±6dB<br>30dB±9dB |
| 8. FM IF | MODE : FM<br>BAND : 14.175MHz<br>SSG : 40dB<br>f : 1kHz<br>DEV : 5kHz | | | | IF | L3–12, 35–38 | ADJ to MAX.<br>Repeat ADJ L3–5 and L7–10 for MAX S meter reading. | |
| | | | | | CONT | L11 | | |
| 9. NB | 1) FREQ : 14.175.0kHz<br>MODE : USB<br>SSG output : 14.175.0kHz | SSG<br><br>DC V.M. | Rear panel | ANT | CONT | L2,3 | MIN (SSG output : 20dB)<br>Lower SSG output to the point where DC voltage falls slightly, and again reset to MIN. | |
| | 2) MODE : USB<br>NB LEVEL : CCW | Noise GEN.<br>S meter | Rear panel | ANT | | | Adjust Noise GEN. level to read to S1. | |
| | 3) NB 1 SW : ON<br>Adjust NB LEVEL control to the point where N.B. action begins. (After checking, turn NB1 SW : OFF) | | | | CONT | L2,3 | MIN (If NB level has insufficient effect, adjust L8 core slightly CCW (out) from peak. | Noise desappears. |
| | 4) NB 2 SW : ON<br>(After checking, shut NB 2 SW OFF) | | | | | | Confirm | The same effect as NB 1 is obtained. |
| | 5) Raise Noise GEN. level to S9.<br>NB1 SW : ON<br>(After checking, turn NB1 SW OFF.) | | | | | | If any noise remains adjust NB LEVEL to find the point where NB operates. | Noise disappears. |
| 10.Buzzer | 1) AF VR : MIN<br>RF VR : MAX (CW)<br>R290 (R205 side) connect to GND on CONT unit. (After ADJ disconnect.) | | | | CONT | VR14 | ADJ for 50mV/8Ω | 50mV/8Ω±3dB |
| | 2) AF VR : MAX<br>RF VR : MIN<br>(CCW) | | | | | | Confirm | 8.0mV/8Ω or less. |

# ADJUSTMENT

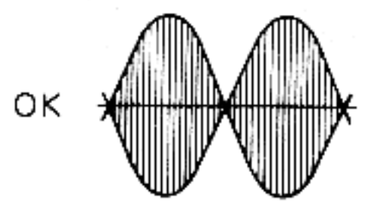
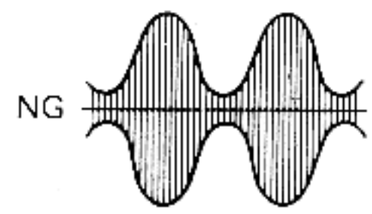
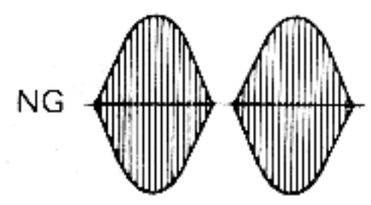
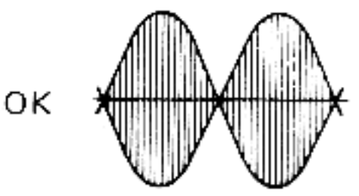
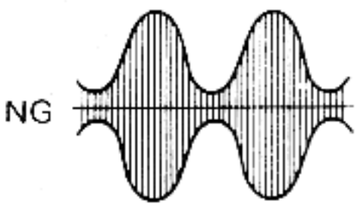
## TX ADJUSTMENT

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 1. Base current confirmation | 1) Display : 14.250MHz<br>MODE : USB<br>STBY : SEND | DC V.M | AVR | FB | | | Connect DC V.M in FINAL DC cable and confirm the flow current. | 1.1—1.5A |
| 2. Drive | 1) Display : 14.250MHz<br>AG : 2.0mV, 1.5kHz<br>Disconnect DRV connector and terminate with a 50Ω dummy load. (After ADJ, remove and reconnect DRV connector.) | AG<br>SCOPE | RF | DRV | IF | L29, 31, 34—36 41,42, 44—46 | ADJ to MAX.<br>**Note :**<br>While adjusting each coil, be keep output less than 2Vp-p by MIC GAIN or CAR VR control.<br>2) Repeat ADJ L46, 50, 51 and 52. | Greater than 2.3V p-p |
| | | | | | RF | L50—52 | | |
| | 2) MODE : CW | | | | IF | L40 | | |
| 3. TX BPF 1.7—30MHz | 1) RF ATT : 0dB<br>FREQ : 14.175MHz<br>STBY : SEND<br>Disconnect DRV connector and terminate with a 50Ω dummy load (After ADJ, reconnected DRV) | SWEEP<br>SCOPE<br>Detector | RF | R49 | RF | VR3<br>L50—57, 60 | ADJ to center.<br>L50, 51, 52 ADJ to MAX.<br>L53, 55, 57 ADJ for 1.7MHz side (A).<br>L54, 56, 60, ADJ for 30MHz side (B).<br>ADJ in upon order, so that wave form shown at right is obtained. (ADJ sweep band A and B separately.) |  |
| 4. Final bias | 1) FREQ : 14,175.0kHz<br>MODE : USB<br>MIC CONTROL : MIN<br>Desolder L7 lead and connect ammeter in its place, minus to L7 side.<br>STBY : SEND<br>(After adjustment, resolder L7 lead.) | DC am meter | FINAL | L7 | FINAL | VR2 | 50mA<br>**Note :** Stabilization requires approximately 20 seconds. | 50mA±10mA |
| | 2) FINAL unit VR1 : MIN<br>Disconnect relay connector in FINAL unit, 28V line and connect ammeter in its place.<br>STBY : SEND<br>(Disconnect ammeter and reconnect this connector after ADJ.) | | | | | VR1 | Read the meter when VR1 is at MIN. Then ADJ VR1 so that the current is increased by 1.3A. | 1.3A±0.2A |
| 5. TX IF AMP | 1) FREQ : 14.175MHz<br>MODE : USB<br>AG : 1500Hz, 2mV<br>METER : ALC<br>STBY : SEND | RF V.M<br>AG<br>8Ω<br>Dummy load | Rear panel | ANT | IF | L40—42, 44—46 | ADJ for MAX ALC meter reading.<br>Repeat ADJ. | |

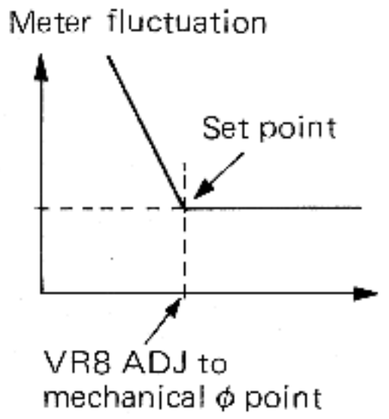
# ADJUSTMENT

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 6. VC, IC METER and current limiter | 1) METER : IC<br>STBY : SEND | | Meter | | CONT | VR10 | Set for mechanism start point. | IC meter<br>Meter fluetuation<br>  <br> |
| | 2) ANT : Connect dummy load<br>METER : VC<br>CONT VR2 : MAX<br>MODE : FSK<br>STBY : SEND<br>PROCESSOR OUT : Set to 10A IC meter reading.<br>(After ADJ, STBY : REC) | DC V.M | AVR | FB | AVR | VR1 | ADJ to 28.5V | 28.5V±0.5V |
| | | | | | CONT | VR11 | ADJ to 28.5V | 28.5V±1V |
| | 3) METER : IC<br>(After ADJ, STBY : REC) | | | | | VR7 | ADJ to 10A | 10A±1A |
| | 4) MODE : CW<br>CAR LEVEL : 10<br>(After ADJ, STBY : REC) | | AVR | FB | | VR6 | Disconnect the FB terminal and connect the current meter between the FB lead and the FB terminal.<br>ADJ to 14A. | 14A±1A |
| 7. Power | 1) BAND : 14.175MHz<br>MODE : CW<br>CAR LEVEL : 10<br>METER : POWER<br>STBY : SEND<br>(After ADJ, STBY : REC) | Power meter | Rear panel | ANT | CONT | VR2 | ADJ to 110W | |
| | | | | | | VR17 | ADJ meter reading to 110W. | 110W±10W |
| 8. Power (Low) | 1) PWR VR : MIN CCW<br>STBY : SEND<br>(After ADJ, STBY : REC<br>PWR VR : MAX CW) | | | | CONT | VR19 | ADJ to 5W | |
| 9. AM Power | MODE : AM<br>METER : POWER<br>STBY : SEND<br>(After ADJ, STBY : REC) | | | | SW | CAR VR | AM power is adjustable with CAR VR. | |
| 10. Protection and SWR | 1) ANT : OPEN<br>METER : Power | | | | CONT | VR5 | ADJ to 10W | 10W±2.5W |
| | 2) ANT : 150Ω Dummy load<br>BAND : 3.750MHz<br>METER : SWR | DC V.M<br>150Ω Dummy load | CONT | IC9- (12) | | VR12 | ADJ to 0.5V | 0.5V±0.01V |
| | | | | | | VR18 | ADJ to "3". | SWR : 3 |
| | 3) ANT : OPEN | | | | | | Confirm | SWR : ∞ |
| | 4) ANT : 50Ω Dummy load | Power meter | | | | | Confirm | SWR less than 1.2 |

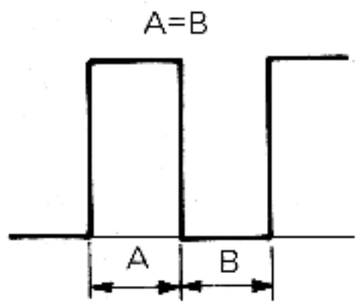
# ADJUSTMENT

| Item | Condition | Measurement: Test equipment | Measurement: Unit | Measurement: Terminal | Adjustment: Unit | Adjustment: Part | Adjustment: Method | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| 11. SSB mode Frequency response | 1) BAND : 14.175MHz<br>MODE : USB<br>AG output : 2 tone, 7mV<br>300Hz, 2700Hz<br>STBY : SEND<br>MIC VR : 50W output | Power meter<br>SCOPE<br>AG | Rear panel | ANT (Directional coupler)<br>MIC | DG-B (CAR) | TC1 | ADJ as shown at right. (Equal 300Hz, 2.700Hz amplitude within 5W.) | OK<br>  <br>NG<br>  |
| | 2) MODE :LSB | | | | | TC2 | Calibrate scope. | NG<br>  |
| | 3) MODE : USB, LSB<br>AG : 1500Hz, 5mV<br>STBY : SEND | | | | | | | |
| | 4) MODE : USB, LSB<br>AG : 2600Hz, 5mV<br>STBY : SEND | | | | | | Confirm | Within 6dB<br>(from 1500Hz) |
| | 5) MODE : USB, LSB<br>AG : 400Hz, 5mV<br>STBY : SEND | | | | | | | |
| | 6) Check carrier suppression after this ADJ. | | | | IF | TC1<br>VR6 | | −50dB or less. |
| 12. FSK | 1) MODE : FSK<br>COMP OUT : MIN<br>AG : 2 tone 0.3V<br>1000Hz, 3400Hz<br>STBY : SEND | AG<br>SCOPE | IF | AFS ㉔ -3<br>ANT (Direcnal coupler) | DG-B (CAR) | TC2<br>TC3 | Turn comp VR CW until get enough signal to measure. ADJ TC2 and TC3 as shown at right. | OK<br>  <br>NG<br>  |
| 13. CAR suppression | 1) FREQ : 14.175.0kHz<br>MODE : USB ↔ LSB<br>MIC CONTROL : MIN<br>STBY : SEND | SCOPE (SPE-ANA) | Rear panel | ANT (through Direcional coupler) | IF | TC1<br>VR6 | MIN (Adjust alternately.)<br>Adjust for no difference between USB and LSB. | |
| | 2) MODE : CW<br>CAR CONTROL : MAX<br>STBY : SEND | | | | | | Calibrate Oscilloscope (SPE-ANA) | |
| | 3) MODE : USB ↔ LSB<br>STBY : SEND | | | | | | Check<br>If less than −50dB, repeat adjustment 1). | −50dB or less. |
| 14. FM Deviation | 1) MODE : FM<br>BAND : 29.25MHz<br>MIC : 1kHz, 50mV<br>FM MIC GAIN : MAX | AG<br>Linear detector | | | CONT | VR16 | 1. Linear detector SET<br>ex.) MS-57A/MS-61A HPF : OFF<br>LPF : 20kHz<br>4101<br>FILTER : 25kHz/15kHz<br>De-emphasis : OFF<br>2. ADJ to ±4.5kHz | DEV ±3kHz with less than 5mV MIC input.<br>DEV ±4.0−6.0kHz with less than 50mV MIC input. |

# ADJUSTMENT

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remark |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 15. ALC Meter | 1) MODE : USB<br>METER SW : ALC<br>MIC VR : MAX<br>AG : 1.5kHz, 5mV<br>STBY : SEND | AG<br>AF V.M<br>Dummy load | S-meter | | CONT | VR8 | ADJ to the mechanical zero point. |  |
| | 2) ALC Meter zero ADJ | | | | SW | MIC GAIN | ADJ for ALC meter zero point. | |
| | 3) AG : 6dB up<br>(After ADJ, STBY : REC) | | | | CONT | VR9 | ADJ for ALC zero MAX. | |
| | 4) MODE : FM<br>BAND : 29.25MHz<br>(After ADJ, STBY : REC) | | | | IF | VR9 | ADJ for ALC zero MAX. | |
| 16. Speech Processor | 1) BAND : 14.250MHz<br>MODE : USB<br>METER : COMP<br>MIC VR : MIN<br>PRO : ON<br>PROCESSOR : 9 o'clock<br>AG (MIC) : 1.5kHz, 1mV<br>STBY : SEND | AG<br>AF V.M<br>Dummy load | Panel<br>Rear panel | MIC<br>ANT | IF | L29, 31—34, 36,41, 42, 44—46 | ADJ for MAX comp meter reading. | |
| | | | | | | VR10 | ADJ for MIN comp meter reading. | |
| | 2) | | | | Panel | Processor IN | ADJ for S1, S-meter reading. | |
| | 3) AG (MIC) : 20dB up<br>(10mV) | | | | IF | VR7 | ADJ for S1 + 20dB comp meter reading. Repeat ADJ 2), 3). | |
| | 4) AG (MIC) : 10dB up<br>(32mV) | | | | | | Confirm the meter reading is increase. | |
| | 5) METER : ALC<br>(After ADJ, STBY : REC) | | | | IF | L33 | ADJ for MAX ALC meter reading. | |
| 17. Monitor Level | 1) AGC : ON<br>MONI : ON<br>AF VR : Set to 0.63V/8Ω point with CAL marker signal.<br>AG (MIC) : 1kHz, 10mV<br>MIC VR : Within ALC zero.<br>STBY : SEND | AF V.M<br>SCOPE | Panel<br>Rear-panel | MIC<br>ANT | IF | L43 | ADJ for MAX ALC meter reading. | |
| | | | | | CONT | VR13 | ADJ to 0.63V/8Ω | 0.63V/8Ω±3dB |
| | 2) MIC terminate with 50kΩ<br>MIC VR : MIN<br>(After ADJ, STBY : REC, MONI : OFF) | | | | | | Don't move AF VR and confirm the hum and noise. | Less than 1.5mV/8Ω |
| 18. MIX Balance | 1) BAND : 21,100.0kHz<br>MODE : AM<br>MIC VR : MIN<br>STBY : SEND | Power meter<br>Monitor receiver (SPE-ANA) | Rear panel | ANT | IF | VR8 | 21.555MHz : MIN (S meter and AF output.) | |
| | 2) MODE : CW<br>STBY : SEND | | | | | VR10 | 29.930MHz : MIN (S meter and AF output.) | |
| | | | | | RF | VR3 | 23.950MHz : MIN (S meter and AF output.) | |

# ADJUSTMENT

| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| 19. Side tone | 1) MODE : CW<br>AF VR : AF output 0.63V/ 8Ω with CAL marker signal.<br>MONI : ON<br>KEY JACK : KEY IN | SCOPE<br>FREQ. C | | | CONT | VR15 | 0.2V/8Ω<br>800Hz | 0.2V/8Ω±6dB<br>800Hz±100Hz |
| | 2) PITCH CONTROL :<br>MIN ↔ MAX | | | | | | Confirm | 800Hz±300Hz or more. |
| 20. AT-940 Auto antenna tuner (If installed.) | 1) BAND : 1.500.00MHz<br>TC1 : Preset to center<br>Disconnect the ③ on AT-B unit, the ⑭ on AT-A unit and jumper between TRQ and TV at the ④ on AT-B unit.<br>CAR VR : MAX, METER : SWR, STBY : SEND<br>Turn VFO frequency (up) until SWR becomes "3"<br>(After ADJ, STBY : REC)<br>STBY : SEND | Oscillo-scope | AT | JP124 | AT-A | VR101 | ADJ as shown at right. |  |
| | 2) Turn VFO frequency (down) until SWR becomes "1.15"<br>(After ADJ, STBY : REC) | | | | | VR102 | ADJ VR102 until ANT TUN indicator just goes off. | |
| | 3) BAND : 18,000.0MHz<br>STBY : SEND<br>(After ADJ, STBY : REC Re-connect the ③ on AT-B and remove jumper between TRQ and TV on connector ④ .) | 20Ω & 150Ω Dummy load | | | | TC1 | ADJ for motor stops and SWR reads MIN. | |
| | 4) Check at the each center frequencyof the HAM BAND | | | | | | Confirm | SWR 1.2 or less. |

## Microprocessor operation check

| Item | Condition | Operation check |
|---|---|---|
| 1. Reset | 1) POWER SW : ON ↔ OFF<br>Then, pressing A=B SW, power SW on.<br><br>Push S1 on LCD unit | Display :<br>VFO A<br>14.000.00<br>USB<br>Sub display :<br>"TRIO-KENWOOD" |
| 2. RIT/XIT | 1) Turn RIT, XIT encoder knob UP ↔ DOWN | Display frequency in-crease or decrease smooth. |
| | 2) Push RIT SW (ON) once | Display RIT and tone sounds. |
| | 3) STBY : SEND<br>(After check, STBY : REC) | Same frequency as RIT off. |
| | 4) Push RIT SW (off) once. | Display RIT light off and tone sounds. |
| | 5) Push XIT SW (on) once. | Display XIT on and tone sounds. |

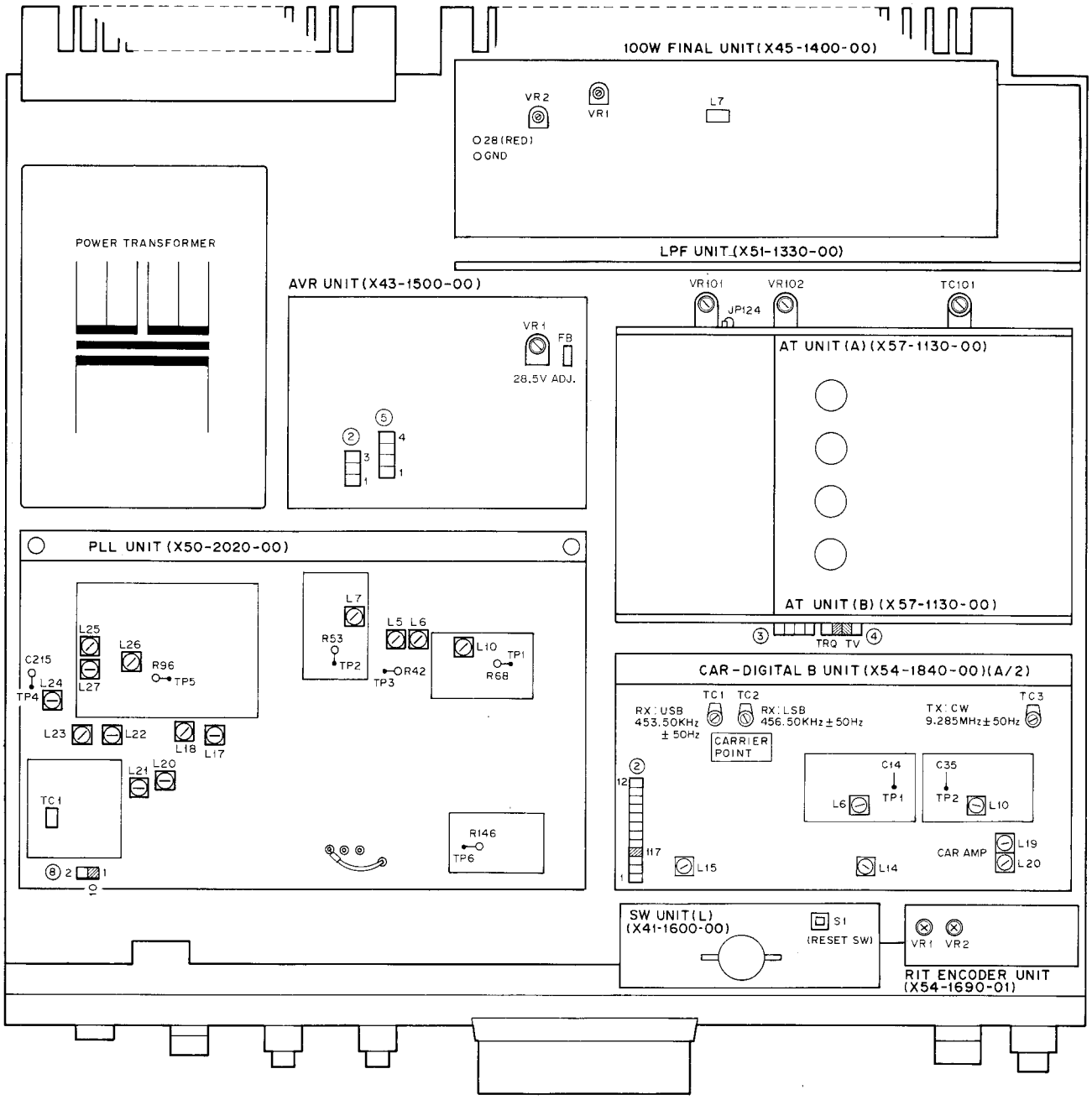
| Item | Condition | Operation check |
|---|---|---|
| 2. RIT/XIT | 6) Push XIT SW (off) once. | Display XIT light off and tone sounds. |
| | 7) Push clear SW | RIT frequency display changes to "00". |
| 3. Function | 1) Push SPLIT SW once. | SPLIT light on (orange). |
| | 2) Push T-F SET SW once. | Display :<br>VFO B<br>" 14.000.00 "<br>While pressing. |
| | 3) Push A/B SW once. | Display : "VFO B"<br>" 14.000.00 "<br>and tone sounds. |
| | 4) STBY : SEND | Display : "VFO A" |
| | 5) STBY : REC | Display : "VFO B" |

# ADJUSTMENT

| Item | Condition | Operation check |
|---|---|---|
| 3. Function | 6) Push A=B SW once. | Tone sounds. |
| | 7) Push A/B SW once. | Display : "VFO A" "14.000.00" and tone sounds. |
| | 8) Push F.LOCK SW (on) once. | Display : F.LOCK and tone sounds. |
| | 9) Turn VFO knob. | Confirm the display frequency doesn't change. |
| | 10) Push 1.5 SW. | Doesn't change any. |
| | 11) Push F.LOCK SW (off) once. | Display F.LOCK light off and tone sounds. |
| | 12) Push ENT → 1 → 2 → 3 → 4 → 5 → 6 → 7 SW's | Display : "1 2 3 4 5 6 7" |
| | 13) Push VOICE SW. (Install the option voice synthesizer unit VS-1.) | Sounds verifies displaced frequency. |
| | 14) Push SPLIT SW once. | Display : SPLIT, orange light off. |
| 4. Memory | 1) Push 29 SW | CH / FREQ / MODE |
| | 2) Push both SW M.IN and 1 once then enter the MEMO as on right chart. | 1 29.000.00 CW<br>2 28.000.00 CW<br>3 27.000.00 USB<br>4 26.000.00 USB<br>5 25.000.00 LSB<br>6 24.000.00 LSB<br>7 23.000.00 AM<br>8 22.000.00 AM<br>9 21.000.00 FM<br>10 21.005.00 FSK |
| | 3) Push PG.S SW (on) once. | Orange light on and scans from "21.000.00" to "21.005.00" on "FM" mode. |
| | 4) Push HOLD SW (on) once and turn main VFO knob. | Red LED light on and tone sounds. Scans manually by VFO knobs. |
| | 5) Push HOLD SW (off) once. | Red LED light off and tone sounds, then, starts auto-scan. |
| | 6) Push PG.S SW (off) once. | Orange LED light off and tone sounds. |
| | 7) Push MS SW (on) once. | Green LED and MEM light on and tone sounds. Scans MEMO from MEMO1 to MEMO0, (skips memorized channels.) |
| | 8) Push MS SW (off) once. | Green LED light off and tone sounds. |
| | 9) Push both M.CE and 1 switches. | Tone sounds. |

| Item | Condition | Operation check |
|---|---|---|
| 4. Memory | 10) Push VFO/M → 1 SW | Display : " . . " "MEMO 1" |
| | 11) Push 4 SW | Display : "26.000.00" "MEMO 4" |
| | 12) Push M►VFO SW | Display : "26.000.00" "VFO A" |
| 5. Timer | 1) Push "S1" on LCD unit. | Display : "TRIO-KENWOOD" |
| | 2) Push "CLOCK" SW once. | Display : 0 : 00 off 0 : 00 on 0 : 00 |
| | 3) Push "SET" SW once. | 0 ? 00 off 0 : 00 on 0 : 00 |
| | 4) Push "MODE" SW once. | 0 : 00 off 0 ? 00 on 0 : 00 |
| | 5) Push "MINUTE" SW once. | 0 : 00 off 0 ? 00 on 0 : 00 |
| | 6) Push "MODE" SW once. | 0 : 00 off 0 : 01 on 0 ? 00 |
| | 7) Push "MINUTE" SW twice. | 0 : 00 off 0 : 01 on 0 : 02 |
| | 8) Push "MODE" SW once. | 0 : 00 off 0 : 01 on 0 : 02 |
| | 9) Push "TIMER" SW (on). | |
| | 10) Push " SCROLL" SW once. | Display : V-B 14.000.00 US 1M1 . . |
| | 11) Push "SCROLL" SW once and confirm the display changes as shown at right. Ten times round one cycle. | V-B 14.000.00 US<br>1M2 28.000.00 CW<br>V-B 14.000.00 US<br>1M3 27.000.00 US<br>V-B 14.000.00 US<br>1M4 26.000.00 US<br>V-B 14.000.00 US<br>1M5 25.000.00 LS<br>V B 14.000.00 US<br>1M6 24.000.00 LS<br>V-B 14.000.00 US<br>1M7 23.000.00 AM<br>V-B 14.000.00 US<br>1M8 22.000.00 AM<br>V-B 14.000.00 US<br>1M9 21.000.00 FM<br>V-B 14.000.00 US<br>1M0 21.005.00 FS<br>V-B 14.000.00 US<br>V-A 14.000.00 US |
| | 12) Switch to "MEMORY BAND 2" | V-B 14.000.00 US 2M1 . . |
| | 13) Switch to "MEMORY BAND 3" | V-B 14.000.00 US 3M1 . . |
| | 14) Switch to "MENORY BAND 4" | V-B 14.000.00 US 4M1 . . |

TOP VIEW




**PLL UNIT (X50-2020-00)**

L5–7 : PLL-2 adj. (35.5–40.5MHz)
L10 : PLL-1 adj. (100–110MHz)
L17,18,20–24
: PLL IF adj.
L25–27 : PLL BPF adj. (9.5–44MHz)
TC-1 : STD freq' adj (20MHz)

**AT UNIT (A) (X57-1130-00)**

VR101 : Waveform ratio (A=B)
VR102 : ANT TUNE indicator goes off

TC101 : Motor stop and SWR reads MIN

**100W FINAL UNIT (X45-1400-00)**

VR1 : 130mA +100mA, –50mA (100W Final bias)
VR2 : 50mA ± 10mA (10W Final bias)

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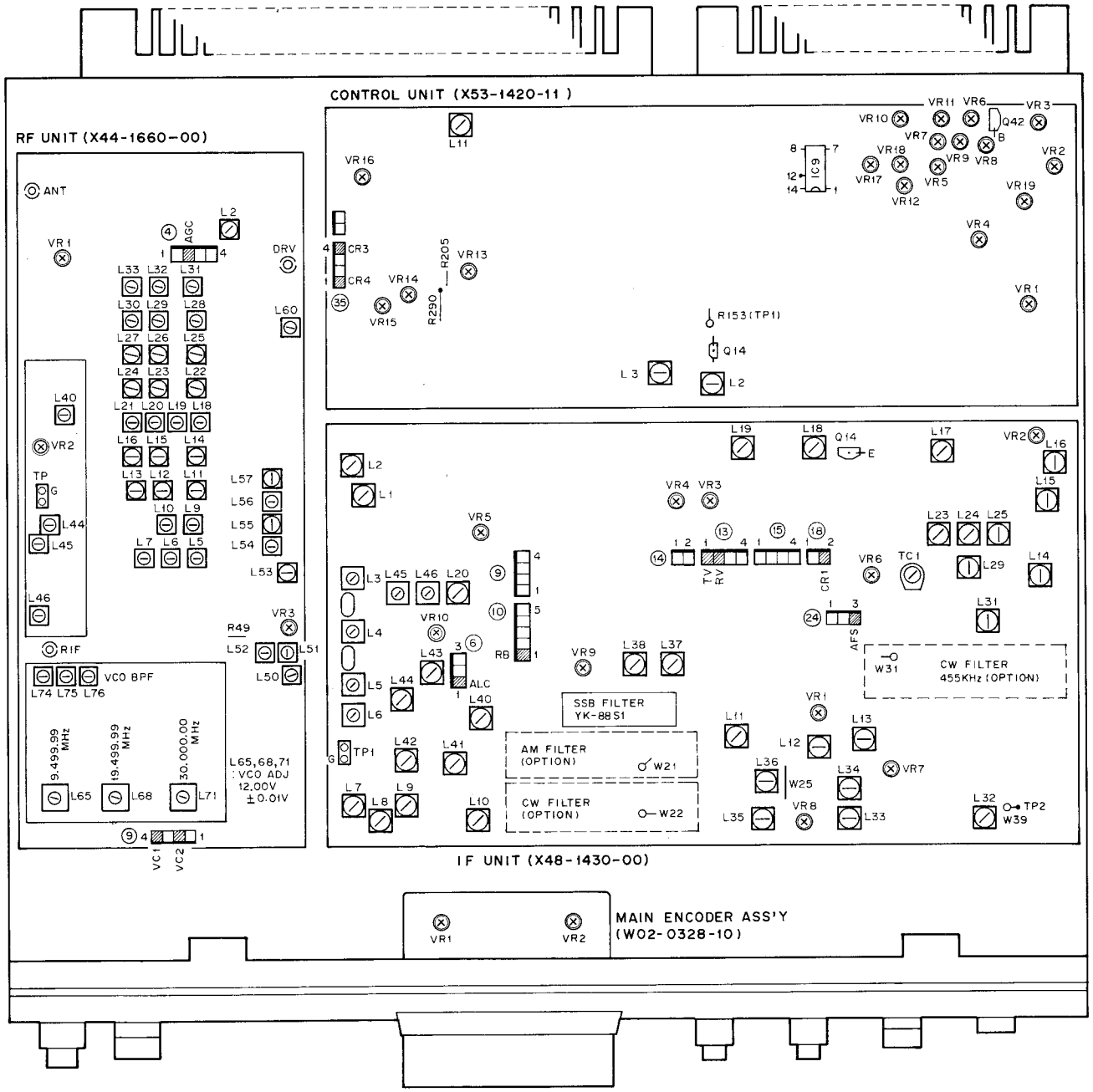
## BOTTOM VIEW




### RF UNIT (X44-1660-00)

| | |
|---|---|
| L2,40 | : IF TRAP adj. (BAND 1.400MHz, SSG : 45.05MHz 80dB) |
| L5–7 | : BPF 100–500kHz (Freq. : 300.0kHz) |
| L9,10 | : BPF 0.5–1.5MHz (Freq. : 1,000.0kHz) |
| L11–13 | : BPF 1.5–3.0MHz (Freq. : 1,900.0kHz) |
| L14–16 | : BPF 3.0–4.0MHz (Freq. : 3,900.0kHz) |
| L18–21 | : BPF 4.0–7.0MHz (Freq. : 6,900.0kHz) |
| L22–24 | : BPF 7.0–8.5MHz (Freq. : 7,000.0kHz) |
| L25–27 | : BPF 8.5–14MHz (Freq. : 10,000.0kHz) |
| L28–30 | : BPF 14.0–20.0MHz (Freq. : 18,000.0kHz) |
| L31–33 | : BPF 20.0–31.0MHz (Freq. : 29,500.0kHz) |
| L44–46 | : MCF (Center freq. : 45.050MHz) |
| L50–52 | : DRIVE adj. |
| L53,55,57 | : TX BPF 1.7MHz Side (A) |
| L54,56,60 | : TX BPF 30MHz Side (B) |
| L65 | : VCO1 adj. (9.499.99MHz) } 12.00V±0.01V |
| L68 | : VCO2 adj. (19.499.99MHz) } 12.00V±0.01V |
| L71 | : VCO3 adj. (30.000.00MHz) } 12.00V±0.01V |
| L74–76 | : VCO BPF |
| VR1 | : RF AGC adj. (AF output 0.2dB down) |
| VR2 | : MIXER BALANCE adj. |
| VR3 | : MIXER BALANCE adj. (CW 23.950MHz) |

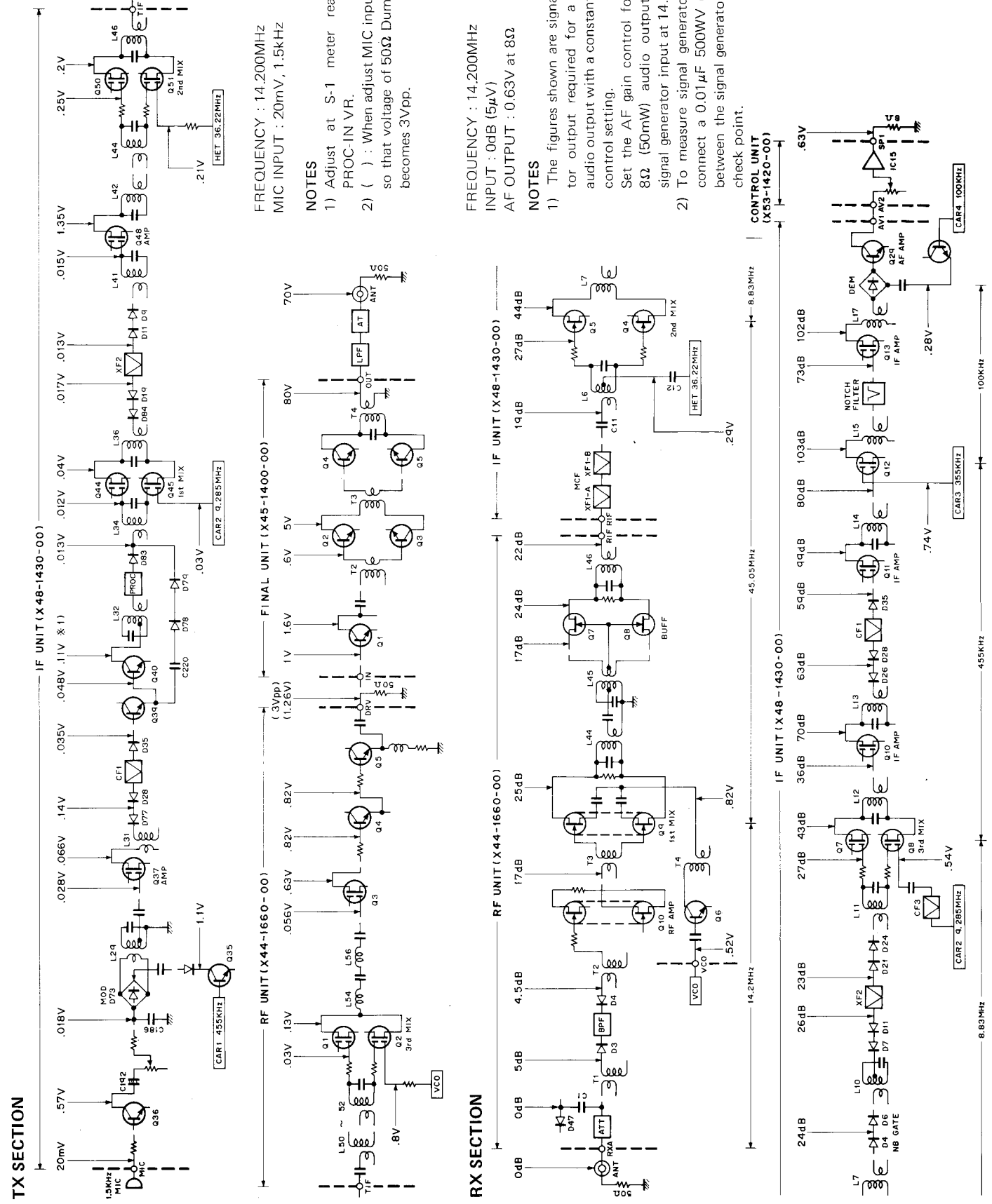
### IF UNIT (X48-1430-00)

| | |
|---|---|
| L1,2 | : IF OUT adj. (8.83MHz) |
| L3–6 | : MCF adj. (RF unit : L44–46) |
| L7–15,17,23–25 | : SSB IF GAIN adj. |
| L16 | : NOTCH adj. |
| L18,19 | : CAR4 adj. (99.20kHz±20Hz) |
| L20 | : CAR3 adj. (100.0kHz±20Hz) |
| L29,31,34–36,40–42,44–46 | : DRIVE adj. |
| L32 | : COMP LEVEL adj. |
| L33 | : ALC LEVEL adj. |
| L43 | : MONI LEVEL adj. |
| L37,38 | : FM IF GAIN adj. |
| VR1 | : RX S-meter Sens. S-1 |
| VR2 | : NOTCH adj. (VR2 and L16) |
| VR3 | : RX S-meter $\phi$ adj. |
| VR4 | : RX S-meter Sens. S-9 |
| VR5 | : AGC adj. 3.2V |
| VR6 | : CARRIER SUPPRESSION adj. (VR6 and TC1) |
| VR7 | : COM LEVEL adj. (VR7 and L32) |
| VR8 | : MIXER BALANCE adj. 21.555MHz (AM 21.1MHz) |
| VR9 | : ALC LEVEL adj. (FM 29.25MHz) |
| VR10 | : MIXER BALANCE adj. (CW 29.930MHz) |

### CONTROL UNIT (X53-1420-11)

| | |
|---|---|
| L2,3 | : SSB IF GAIN (MIN. adj.) |
| L11 | : FM IF GAIN |
| VR1 | : RB adj. 2.1V |
| VR2 | : MAX POWER adj. (110W) |
| VR3 | : ALC adj. 3.2V |
| VR5 | : SWR protection adj. (100W) |
| VR6 | : Current protection adj. 14A |
| VR7 | : IC meter adj. 10A |
| VR8 | : ALC-$\phi$ adj. |
| VR9 | : ALC meter adj. |
| VR10 | : IC-$\phi$ adj. |
| VR11 | : VC meter adj. 28.5V |
| VR12 | : SWR standerd adj. 0.5V |
| VR13 | : MONITOR LEVEL adj. |
| VR14 | : BUZZER LEVEL adj. |
| VR15 | : Side tone level |
| VR16 | : DEV. |
| VR17 | : Power meter adj. |
| VR18 | : SWR meter adj. |
| VR19 | : MIN. power adj. (5W) |

# LEVEL DIAGRAM



| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| **SWITCH UNIT (L)** | | | | |
| ① | 1 | VBY | I | VS-1 Busy signal |
| | 2 | VSR | O | VS-1 voice synthesizer start signal |
| | 3 | PS4 | O | VS-1 voice synthesizer data |
| | 4 | PS0 | O | |
| | 5 | PS1 | O | |
| | 6 | PS2 | O | |
| | 7 | PS3 | O | |
| | 8 | 5C1 | O | + 5V for VS-1 |
| ② | 1 | 21T | I | + 21V |
| | 2 | GND | | GND |
| ③ | 1 | SB0 | I | Display data for LCD |
| | 2 | SB1 | I | |
| | 3 | SB2 | I | |
| | 4 | SB3 | I | |
| | 5 | MRQ | I | Clock for data |
| | 6 | GND | | GND |
| ④ | 1 | GND | | GND |
| | 2 | RS | O | Resister, select signal (LCD ass'y control data) |
| | 3 | RW | O | Write/Read signal (LCD ass'y control data) |
| | 4 | LE | O | Latch signal (LCD ass'y control data) |
| | 5 | DB4 | O | Data (LCD ass'y control data) |
| | 6 | DB5 | O | |
| | 7 | DB6 | O | |
| | 8 | DB7 | O | |
| | 9 | 5L | | + 5V for LCD ass'y |
| | 10 | LG | O | LCD Intensity control bias, −3V approx. |
| ⑤ | 1 | GND | | GND |
| | 2 | HS | O | LCD data accept signal message |
| | 3 | 5C | O | + 5V for Digital B unit |
| | 4 | 8B | O | + 8V for Digital B unit |
| ⑥ | 1 | 8C | I | + 8V |
| | 2 | GND | | GND |
| | 3 | TMY | O | Timer output, Timer SW ON, Timer SW OFF : H |
| ⑦ | 1 | TMY | I | Timer SW OFF : L |
| | 2 | TMR | I | Timer SW ON : L |
| ⑧ | 1 | ATV | I | AT unit TX data |
| | 2 | TNQ | I | AT unit STBY signal |
| ⑨ | 1 | 5K | I | + 5V |
| | 2 | SET | | SET KEY (Key on : L) |
| | 3 | GRP | I | GRAPH KEY (Key on : L) |
| | 4 | SCR | I | SCROLL KEY (Key on : L) |
| | 5 | CLK | I | CLOCK KEY (Key on : L) |
| | 6 | GND | | GND |
| ⑭⑨ | 1 | GND | | GND |
| | 2 | LG | | Sub diaplay contrast |
| | 3 | VE | | |
| **SWITCH UNIT (I)** | | | | |
| ⑩ | 1 | VB0 | O | Bit 0 (Code, data for VBT, SLOPE TUNE) |
| | 2 | VB1 | O | Bit 1 |
| | 3 | VB2 | O | Bit 2 |
| | 4 | VB3 | O | Bit 3 |
| | 5 | VB4 | O | Bit 4 |
| ⑪ | 1 | VB | | VBT (Code select data) |
| | 2 | SH | I | SLOPE HIGH cut (Code select data) |
| | 3 | SL | I | SLOPE LOW cut (Code select data) |
| **SWITCH UNIT (A)** | | | | |
| ⑫ | 1 | TM | O | Meter SW common |
| | 2 | SSB | I | SSB mode : 15V |
| | 3 | CWB | I | CW mode : 15V |
| | 4 | MA | I | AM, SSB mode : 15V |
| ⑬ | 1 | 15B | I | + 15V |
| | 2 | MS | O | Power supply for monitor, MONI SW ON : 15V |
| | 3 | FBK | O | CW mode FULL/SEMI SW, FULL : 15V |
| | 4 | VS2 | O | CW mode VOX SW ON : 15V |
| | 5 | VS1 | O | AM, SSB mode VOX SW ON : 15V |
| | 6 | SS | O | STBY SW, MIC PTT ON : 0V |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ⑭ | 1 | SPL | I | SPLIT LED light on |
| | 2 | DIM | O | DIM SW output, OFF : 0V |
| | 3 | TX | I | STBY control by μ-com, SEND : H, REC : L |
| ⑮ | 1 | ATT1 | O | ATT relay drive 0, 20dB : 15V |
| | 2 | ATT2 | O | ATT relay drive 0, 10dB : 15V |
| ⑯ | 1 | NAR | I | NAR LED control for Mode |
| | 2 | 15V | | + 15V |
| | 3 | CWB | I | CW mode : 15V |
| | 4 | SS | I | MIC PTT ON : 0V |
| | 5 | WIDE | O | NAR SW OFF : 5V (approx.) |
| ⑰ | 1 | ATI | O | AUTO/THRU SW AUTO : 15V |
| | 2 | TUN | I | AT tuning : H |
| ⑱ | 1 | 15B | I | + 15V |
| | 2 | NB1 | O | NB1 SW |
| | 3 | NB2 | O | NB2 SW ON : H |
| ⑲ | 1 | PRM | I | COMP meter |
| | 2 | MVG | | Mic line GND |
| | 3 | PRS | O | SSB mode PROC SW ON : 15V |
| | 4 | MV2 | O | MIC GAIN/PROC-IN VR |
| ⑳ | 1 | GND | | GND |
| | 2 | PIL | I | PROC-IN VR OUT |
| | 3 | MVG | | MIC line GND |
| | 4 | MVG | | |
| | 5 | MG | I | MIC GAIN VR OUT |
| | 6 | NBL | O | NB LEVEL VR |
| | 7 | 15 | O | + 15V for SW unit (E) |
| ㉑ | 1 | ALM | I | ALC meter |
| | 2 | PWR | I | Power meter |
| | 3 | SWR | I | SWR meter |
| | 4 | ICM | I | IC meter |
| | 5 | VCM | I | VC meter |
| | 6 | AG0 | O | AGC OFF : 15V |
| | 7 | NAF | I | SSB, FSK, CW mode : 15V |
| | 8 | AGS | O | AGC SLOW : 15V, Normally : −12V |
| | | NAI | O | NAR SW ON : H |
| | | NAR | I | NAR LED control for MODE |
| | | TUN | O | TUNE LED light ON |
| | | SPL | O | SPLIT LED light ON |
| | | PL | O | Power supply for meter lamp |
| | | G | | GND for meter lamp |
| **SWITCH UNIT (D)** | | | | |
| ㉒ | 1 | CWB | I | CW mode : 15V |
| | 2 | GND | | GND |
| | 3 | 15V | I | + 15V |
| ㉓ | 1 | AP5 | O | CW mode AF TUNE ON : 15V |
| | 2 | AP0 | O | CW mode AF TUNE OFF : 15V |
| | 3 | NTH | O | NOTCH SW ON : 15V |
| | 4 | 15V | O | + 15V for SW unit (C) |
| ㉔ | 1 | GND | | GND |
| | 2 | RCL | O | CLEAR SW (ON : L) |
| | 3 | XIT | O | XIT SW (ON : L) |
| | 4 | RIT | O | RIT SW (ON : L) |
| **SWITCH UNIT (K)** | | | | |
| ㉕ | 1 | IO2 | I | IF OUT2 (4th IF 100kHz) |
| | 2 | GND | | GND |
| | 3 | LO1 | I | PHONE OUT |
| | 4 | GND | | GND |
| | 5 | GND | | GND |
| | 6 | IO1 | I | IF OUT 1 (8.83MHz) |
| | 7 | GND | | GND |
| | 8 | LN1 | I | PHONE IN |

# TS-940S TERMINAL FUNCTION

| Terminal No. | | Terminal Name | I/O | Terminal Function |
|---|---|---|---|---|
| **SWITCH UNIT (F)** | | | | |
| (26) | 1 | V15 | I | + 15V |
| | 2 | VXC | I | ANTI VOX VR |
| | 3 | VXG | | GND |
| | 4 | ANV | O | ANTI VOX VR |
| | 5 | MVG | | Mic line GND |
| | 6 | FMC | O | FM MIC GAIN VR |
| | 7 | DLY | I | VOX DELAY VR |
| | 8 | VXG | | GND |
| | 9 | VX2 | O | VOX GAIN VR |
| (27) | 1 | MVG | | Mic line GND |
| | 2 | MV1 | I | FM MIC GAIN VR, VOX GAIN VR |
| (28) | 1 | CV2 | O | } CAR VR |
| | 2 | CV1 | I | |
| (29) | 1 | MB0 | O | Memory bank SW data, 2, 3 : H |
| | 2 | MB1 | O | Memory bank SW data, 1, 3 : H |
| | 3 | 100 | O | VFO : 100kHz SCALE DATA : L |
| | 4 | 10 | O | VFO : 10kHz DIGIT DATA : L |
| (30) | 1 | GND | | GND |
| | 2 | MKS | O | MARKER SW ON : L |
| (48) | 1 | GND | | GND |
| | 2 | LG | | } Sub display contrast |
| | 3 | VE | | |
| **SWITCH UNIT (J)** | | | | |
| (31) | 1 | TMY | O | TIMER SW OFF : L |
| | 2 | GND | | GND |
| | 3 | TMR | O | TIMER SW ON : L |
| **SWITCH UNIT (G)** | | | | |
| (32) | 1 | 8V | I | + 8V |
| | 2 | MD | O | MIC DOWN SW |
| | 3 | MU | O | MIC UP SW |
| | 4 | SS | O | PTT SW |
| | 5 | MIC | O | MIC COM |
| | 6 | GND | | MIC GND |
| | 7 | GND | | GND |
| **SWITCH UNIT (H)** | | | | |
| (33) | 1 | GND | | GND } ACC2 |
| | 2 | REC | O | RX AFSK signal |
| | 3 | MSL | O | MIC select |
| | 4 | SS | I | STBY control |
| | 5 | MIN | I | TX AFSK signal |
| | 6 | GND | | GND |
| | 7 | GND | | GND |
| **SWITCH UNIT (M)** | | | | |
| (34) | 1 | XIT | I | XIT display data |
| | 2 | RIT | I | RIT display data |
| | 3 | FG | I | Heater for display tube |
| | 4 | DP | I | Dot display data |
| | 5 | a | I | Segment data a |
| | 6 | SC | I | Scale display data |
| (35) | 1 | MEMO | I | MEMO display data |
| | 2 | P9 | I | Analog digit data |
| | 3 | G5 | I | Grid data No. 5 |
| | 4 | P10 | I | Analog digit data |
| | 5 | G6 | I | Grid data No. 6 |
| | 6 | P4 | I | } Analog digit data |
| | 7 | P3 | I | |
| | 8 | G7 | I | Grid data No. 7 |
| | 9 | P2 | I | } Analog digit data |
| | 10 | P1 | I | |
| | 11 | G8 | I | Grid data No. 8 |
| | 12 | G9 | I | Grid data No. 9 |

| Terminal No. | | Terminal Name | I/O | Terminal Function |
|---|---|---|---|---|
| (36) | 1 | — | I | — (minus) display data |
| | 2 | b | I | Segment data b |
| | 3 | G1 | I | Grid data No. 1 |
| | 4 | P5 | I | Analog digit data |
| | 5 | G2 | I | Grid data No. 2 |
| | 6 | P6 | I | } Analog digit data |
| | 7 | P7 | I | |
| | 8 | G3 | I | Grid data No. 3 |
| | 9 | P8 | I | Analog digit data |
| | 10 | G4 | I | Grid data No. 4 |
| | 11 | c | I | Segment data c |
| | 12 | g | I | Segment data g |
| (37) | 1 | e | I | Segment data e |
| | 2 | d | I | Segment data d |
| | 3 | G10 | I | Grid data No. 10 |
| | 4 | VFO B | I | VFO B display data |
| | 5 | VFO A | I | VFO A display data |
| | 6 | FH | I | Heater for display tube |
| | 7 | LOCK | I | LOCK display data |
| | 8 | f | I | Segment data f |
| **SWITCH UNIT (E)** | | | | |
| (38) | 1 | PC0 | O | TRQ-H : H, Normally : —12V |
| | 2 | —12 | I | —12V |
| | 3 | TRQ | I | AT STBY signal (For power control OFF) |
| (39) | 1 | PRL | O | PROC-OUT VR (DC) |
| | 2 | SFT | I | PROC-OUT VR, SSB, FSK mode TX : 15V |
| | 3 | MVG | | Mic line GND |
| | 4 | MV1 | I | MIC GAIN VR |
| (40) | 1 | NBL | O | NB LEVEL VR |
| | 2 | GND | | GND |
| | 3 | MVG | | Mic line GND |
| | 4 | PIL | O | PROC-IN VR |
| | 5 | 15 | I | + 15V |
| | 6 | MVG | | Mic line GND |
| | 7 | MG | O | MIC GAIN VR |
| | 8 | MVG | | Mic line GND |
| | 9 | MV1 | O | MIC GAIN VR |
| (41) | 1 | GND | | GND |
| | 2 | PC | O | Power control VR |
| (42) | 1 | PC1 | O | } Power control VR |
| | 2 | PC2 | I | |
| **SWITCH UNIT (C)** | | | | |
| (43) | 1 | AP1 | I | } CW PITCH VR |
| | 2 | AP2 | O | |
| | 3 | AP3 | O | } AF TUNE VR |
| | 4 | AP4 | I | |
| | 5 | CWP | O | CW PITCH VR |
| | 6 | NTH | O | NOTCH VR |
| | 7 | AP0 | O | CW mode AF TUNE OFF : 15V |
| | 8 | AP5 | O | CW mode AF TUNE ON : 15V |
| (44) | 1 | AP5 | I | CW mode AF TUNE ON : 15V |
| | 2 | AP0 | I | CW mode AF TUNE OFF : 15V |
| | 3 | 15V | I | + 15V |
| | 4 | GND | | GND |
| | 5 | NTH | I | NOTCH SW ON : 15V |
| (45) | 1 | NTL | O | NOTCH LED light on, NOTCH SW ON : H |
| | 2 | FMG | I | FM mode : 0V |
| (46) | 1 | SQ2 | O | } SQL VR |
| | 2 | SQ1 | I | |
| **SWITCH UNIT (B)** | | | | |
| (47) | 1 | GND | | GND |
| | 2 | AVG | | AF line GND |
| | 3 | AV2 | O | AF GAIN VR |
| | 4 | AVG | | AF line GND |
| | 5 | AV1 | I | AF GAIN VR |
| | 6 | RFG | O | RF GAIN VR |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| **AVR UNIT (X43-1500-00)** | | | | |
| ① | 1 | AC2 | I | AC LINE for AVR (21T) |
| | 2 | AC1 | I | |
| ② | 1 | PE | I | Q103 Emitter |
| | 2 | PC | O | Q103 Collector |
| | 3 | PB | O | Q103 Base |
| ③ | 1 | 28C | O | + 28V to POWER SW |
| | 2 | 28B | I | + 28V from POWER SW |
| ④ | 1 | 21T | O | + 21V for Control unit |
| | 2 | GND | | GND |
| ⑤ | 1 | 21T | O | + 21V for Control unit |
| | 2 | 28C | O | + 28V for Control unit |
| | 3 | 21B | I | + 21V for AVR unit |
| | 4 | GND | | GND |
| ⑥ | 1 | 10E | I | Q104 Emitter |
| | 2 | 10C | O | Q104 Collector |
| | 3 | 10B | O | Q104 Base |
| ⑦ | 1 | 10V | I | + 10V for IC101 : 5V AVR IC |
| | 2 | GND | | GND |
| | 3 | 5V | O | + 5V AVR output |
| ⑧ | 1 | 10L | O | + 10V for LCD ass'y |
| | 2 | GND | | GND |
| ⑨ | 1 | 5CO | O | + 5V for Control unit |
| | 2 | 5IF | O | + 5V for IF unit |
| | 3 | GND | | GND |
| | 4 | 5KE | O | + 5V for key board ass'y |
| | 5 | GND | | GND |
| | 6 | 5DA | O | + 5V for Digital A unit |
| | 7 | GND | | GND |
| | 8 | 10DA | O | + 10V for Digital A unit |
| ⑩ | 1 | ICA | O | Detect terminal for VC, IC meter |
| | 2 | ICB | O | Detect terminal for IC meter |
| ⑪ | 1 | FAN | O | Fan motor control output |
| | 2 | GND | | GND |
| ⑫ | 1 | 40V | I | 40V DC inline |
| | 2 | BS1 | O | Q102 Base |
| | 3 | BS2 | O | Q101 Base |
| ⑬ | 1 | THM | I | Thermister TH101 output |
| | 2 | 18 | O | + 18V for thermister TH101 |
| | | 28A | I | Q101, 102 output |
| | | FB | O | + 28V for Final unit |
| | | 5G | | 5V LINE GND |
| | | CG | | Chassis GND |
| | | FG | O | FINAL GND |
| **RF UNIT (X44-1660-00)** | | | | |
| ① | 1 | ATT1 | I | ATT SW data, 0, 20dB : H |
| | 2 | ATT2 | I | ATT SW data, 0, 10dB : H |
| ② | 1 | GND | | GND |
| | 2 | MKR | I | Marker signal (100kHz) |
| ③ | 1 | ATV | I | Bias for ANT switching (TX : H) |
| | 2 | RV | I | RX : 15V |
| ④ | 1 | RV | O | RV (RX : 15V) for IF unit |
| | 2 | AGC | I | AGC voltage for RF AGC circuit |
| | 3 | TB | O | TB (TX : 2.1V) for IF unit |
| | 4 | TV | O | TV (TX : 15V) for IF unit |
| ⑤ | 1 | GND | | GND |
| | 2 | PC | I | Power control (Q3 GAIN control) |
| | 3 | TRQ | I | AT STBY signal (Q3 GAIN DOWN) |
| ⑥ | 1 | VCH | O | NC |
| | 2 | TB | I | TX : + 15V, RX : −12V |
| | 3 | 18 | I | + 18V |
| | 4 | NC | | NC |
| | 5 | TV | I | TX : + 15V |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ⑦ | 1 | RB0 | I | RX BPF band data |
| | 2 | RB1 | I | |
| | 3 | RB2 | I | |
| | 4 | RB3 | I | |
| ⑧ | 1 | VCL | I | Main VCO select signal |
| | 2 | VCM | I | |
| ⑨ | 1 | TCB | O | Power supply for PLL unit IC18 |
| | 2 | VC2 | I | VCO3 control voltage |
| | 3 | GND | | GND |
| | 4 | VC1 | I | VCO1, VCO2 control voltage |
| | | RIF | O | RX 1st IF (45.05MHz) |
| | | TIF | I | TX IF (45.05MHz) |
| | | XVTR | O | TX drive output to X.VERTER 7 pin |
| | | RXA | I | RX signal input |
| | | EXTA | O | To EXT. ANT SW |
| | | ANT | I | From Antenna connector |
| | | XVR | I | X.VERTER 4 pin |
| | | TXA | I | TX POWER |
| | | DRV | O | Drive output to Final unit |
| | | VCO | O | VCO signal output to PLL unit |
| **100W FINAL UNIT (X45-1400-00)** | | | | |
| ① | 1 | TXC | I | TX control, TX : 15V |
| | 2 | GND | | GND |
| | 3 | TH | O | Final thermal sensor |
| | | IN | I | Drive power input |
| | | OUT | O | Power output |
| | | 28 | I | + 28V |
| | | GND | I | GND |
| **DC-DC UNIT (X46-1030-00)** | | | | |
| ① | 1 | HV | O | High voltage for display drive (approx. −40V) |
| | 2 | FG | O | Filament voltage for display |
| | 3 | FH | O | |
| | 4 | 5V | O | + 5V for Digital C unit |
| | 5 | GND | | GND |
| ② | 1 | DIM | I | DIM SW OFF : 0V |
| | 2 | GND | | GND |
| | 3 | 5V | I | + 5V |
| ③ | 1 | 21B | I | + 21V for AVR UNIT |
| | 2 | −C | O | −40V for −12V power supply for Control unit |
| **IF UNIT (X48-1430-00)** | | | | |
| ① | 1 | 101 | O | IF OUT1 (8.83MHz) |
| | 2 | GND | | GND |
| | 3 | LN1 | I | PHONE IN |
| | 4 | GND | | GND |
| | 5 | MSL | I | Mic select signal for ACC2-9 pin |
| | 6 | GND | | GND |
| | 7 | MIN | I | TX AFSK signal for ACC2-11 pin |
| | 8 | GND | | GND |
| | 9 | REC | O | RX AFSK signal for ACC2-3 pin |
| ② | 1 | MIC | I | Mic input |
| | 2 | GND | | GND |
| ③ | 1 | MV1 | O | MIC GAIN VR |
| | 2 | MVG | | Mic line GND |
| | 3 | SFT | O | To PROC-OUT VR (SSB, FSK mode TX : 15V) |
| | 4 | PRL | I | PROC-OUT VR (DC) |
| ④ | 1 | TBK | I | TX : 15V |
| | 2 | −12 | I | −12V |
| | 3 | CR3 | O | CR3 for SIDE TONE (100kHz) |
| | 4 | GND | | GND |
| | 5 | CWG | O | CWG for Control unit, CW mode : 0V |
| ⑤ | 1 | TM | I | TX meter amp |
| | 2 | MA | O | AM, SSB mode : 15V |
| | 3 | SSB | O | MOD data for SW unit (A), SSB mode : 15V |
| | 4 | CWB | O | MOD data for SW unit (A), CW mode : 15V |
| ⑥ | 1 | ALC | I | ALC for TX IF control |
| | 2 | GND | | GND |
| | 3 | MON | O | TX IF for SSB, FSK, AM monitor (8.83MHz) |

# TS-940S TERMINAL FUNCTION

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ⑦ | 1 | NG1 | I | Noise blanker gate input |
| | 2 | NBB | O | + B for Noise blanker circuit |
| | 3 | GND | | GND |
| | 4 | NA | O | IF output for Noise blanker |
| ⑧ | 1 | GND | | GND |
| | 2 | 5IF | I | + 5V |
| ⑨ | 1 | USB | O | USB, CW, AM, FM, TUNE : H } CAR 1 |
| | 2 | LSB | O | LSB, FSK : H } f shift |
| | 3 | 5V | O | + 5V for CAR unit |
| | 4 | 15V | O | + 15V for CAR UNIT |
| ⑩ | 1 | RB | I | Bias for RX circuit, RX : 2.1V |
| | 2 | 15V | I | + 15V |
| | 3 | TRQ | I | AT STBY signal |
| | 4 | FMB | O | FM : 15V } Mode data |
| | 5 | AMB | O | AM : 15V } for Control unit |
| ⑪ | 1 | GND | | GND |
| | 2 | CR0 | I | Carrier for TX CW, FM (8.83MHz) |
| ⑫ | 1 | USG | I | USB KEY } |
| | 2 | LSG | I | LSB KEY |
| | 3 | FSG | I | FSK KEY |
| | 4 | AMG | I | AM KEY } KEY ON : L |
| | 5 | FMG | I | FM KEY |
| | 6 | CWG | I | CW KEY } |
| | 7 | WN | I | WIDE/NAR & IF Filter switching data |
| | 8 | MD2 | I | IF Filter switching data |
| | 9 | MD1 | I | IF Filter switching data |
| ⑬ | 1 | TV | I | TX : 15V |
| | 2 | RV | I | RX : 15V |
| | 3 | TB | I | Low voltage for TX circuit |
| | 4 | AGC | O | AGC output for RF unit RF AGC |
| ⑭ | 1 | CV1 | O | DC for CAR VR, CW, AM mode TX : 15V |
| | 2 | CV2 | I | CAR VR output |
| ⑮ | 1 | M | O | Meter output |
| | 2 | NAF | O | DC for AGC SW, SSB, FSK, CW mode : 15V |
| | 3 | AGS | I | AGC SLOW : 15V, Normally : −12V |
| | 4 | AG0 | I | AGC OFF : 15V |
| ⑯ | 1 | FMI | O | FM IF (455kHz) |
| | 2 | GND | | GND |
| | 3 | GND | | GND |
| | 4 | NG2 | I | Noise gate (3rd MIX) control signal for NB2 |
| ⑰ | 1 | GND | | GND |
| | 2 | CR2 | I | CAR2 input (9.285MHz) |
| ⑱ | 1 | GND | | GND |
| | 2 | CR1 | I | CAR1 input (455kHz) |
| ⑲ | 1 | PRS | I | SSB mode PROC SW ON : 15V |
| | 2 | PRM | O | PROC meter |
| | 3 | MVG | | GND |
| | 4 | MV2 | I | MIC GAIN/PROC-IN VR |
| ⑳ | 1 | GND | | GND |
| | 2 | IO2 | O | IF OUT 2 (100kHz) |
| ㉑ | 1 | GND | | GND |
| | 2 | CR4 | O | CAR4 for SIDE TONE (99.2kHz) |
| | 3 | MUT | I | SQL MUT signal, Muting : H |
| | 4 | FMV | I | FM Detector signal |
| | 5 | GND | | GND |
| ㉒ | 1 | AP0 | I | CW mode AF TUNE OFF : 15V |
| | 2 | AP5 | I | CW mode AF TUNE ON : 15V |
| | 3 | AP4 | O | AF TUNE VR |
| | 4 | AP2 | I | } CW PITCH VR |
| | 5 | AP1 | O | |
| | 6 | AP3 | I | AF TUNE VR |
| | 7 | NTH | I | NOTCH VR |
| | 8 | CWP | I | CW PITCH VR |
| ㉓ | 1 | AV1 | O | AF GAIN VR |
| | 2 | AVG | | GND |
| | 3 | GND | | GND |
| | 4 | RFG | O | RF GAIN VR |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ㉔ | 1 | FSB | O | FSK mode data, FSK : 15V |
| | 2 | GND | | GND |
| | 3 | AFS | I | AFSK modulate signal (2290/2125Hz) |
| | | TIF | O | TX IF signal (45.05MHz) |
| | | RIF | I | RX 1st IF signal (45.05MHz) |
| | | HET | I | HET (36.22MHz) |
| **PLL UNIT (X50-2020-00)** | | | | |
| ② | 1 | DA0 | O | } PLL data for CAR1, CAR2 |
| | 2 | DA1 | O | |
| | 3 | DA2 | O | |
| | 4 | DA3 | O | |
| | 5 | UL1 | I | Unlock signal |
| ③ | 1 | GND | | GND |
| | 2 | DA0 | I | } PLL data |
| | 3 | DA1 | I | |
| | 4 | DA2 | I | |
| | 5 | DA3 | I | |
| | 6 | CL2 | I | Data clock for IC8 |
| | 7 | CL1 | I | Data clock for IC9 |
| | 8 | CL0 | I | Data clock for IC19 |
| ④ | 1 | GND | | GND |
| | 2 | 117 | I | 117MHz from CAR unit |
| ⑤ | 1 | FMM | I | FM modulate signal |
| | 2 | GND | | GND |
| | 3 | 15A | I | + 15V |
| | 4 | UL | O | PLL unlock signal |
| | 5 | 5 | I | + 5V |
| ⑥ | 1 | KFS | I | RTTY KEY signal, KEY DOWN : L |
| | 2 | GND | | GND |
| | 3 | MKR | O | 100kHz marker signal output |
| | 4 | MKG | | NC |
| | 5 | GND | | GND |
| | 6 | MKS | | Marker ON : L, Normally : H |
| ⑦ | 1 | AFS | O | AFSK signal (2290/2125Hz) |
| | 2 | GND | | NC |
| | 3 | FSB | I | FSK mode data, FSK : 15V |
| ⑧ | 1 | 10 | O | 10MHz for CAR unit |
| | 2 | GND | | GND |
| ⑩ | 1 | TCB | I | Power supply for IC18 |
| | 2 | VC2 | O | Control voltage for RF unit VCO3 |
| | 3 | GND | | GND |
| | 4 | VC1 | O | Control voltage for RF unit VCO1, 2 |
| ⑪ | 1 | GND | | GND |
| | 2 | PLE | I | Data latch for IC17 |
| | 3 | CL3 | I | Clock for IC17 |
| | 4 | PLD | I | PLL data IC17 |
| | | HET | O | HET for RF unit (36.22MHz) |
| | | VCO | I | Output signal of RF unit, VCO1, 2 and 3 |
| **LPF UNIT (X51-1330-00)** | | | | |
| ① | 1 | VSF | O | Forward detect for SWR |
| | 2 | GND | | GND |
| | 3 | VSR | O | Reverse detect for SWR |
| | 4 | GND | | GND |
| ② | 1 | ANT | O | LPF unit output |
| ③ | 1 | GND | | GND |
| | 2 | XVR | I | X. VERTER 4 pin |
| ④ | 1 | TXC | O | TX control for Final unit, TX : 15V |
| | 2 | GND | | GND |
| | 3 | TH | I | Final thermal sensor |
| ⑤ | 1 | LP2 | I | } LPF band data |
| | 2 | LP0 | I | |
| | 3 | LP1 | I | |
| ⑥ | 1 | M0 | O | Fan control |
| | 2 | GND | | GND |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ⑦ | 1 | 21B | I | + 21V for AVR unit |
| | 2 | 28 | I | + 28V |
| | 3 | TV | I | TX : 15V |
| | 4 | BTP | O | PROTECTION signal (H : TX OFF) |
| | | IN | I | LPF unit input |
| **CONTROL UNIT (X53-1420-11)** | | | | |
| ① | 1 | VCH | I | NC |
| | 2 | TB | O | TB for RF unit, TX : 2.1V |
| | 3 | GND | | GND |
| | 4 | TV | O | TV for RF unit, TX : 15V |
| | 5 | 18 | O | + 18V for RF unit |
| ② | 1 | TRQ | I | AT STBY signal, TUNE : Power down |
| | 2 | 15B | O | + 15V for AT unit |
| | 3 | 21B | O | + 21V for AT unit |
| | 4 | TV | O | TV for AT unit |
| ③ | 1 | GND | | GND |
| | 2 | 28C | I | + 28V |
| | 3 | 21B | O | + 21V for AVR unit |
| | 4 | 21T | I | + 21V |
| ④ | 1 | EX2 | | For REMOTE connector, |
| | 2 | EX1 | | TX : Connecto to EX1, EX2 |
| ⑤ | 1 | 8C | | + 8V for SW unit (L) |
| | 2 | TMY | | TIMER SW ON : 0V |
| | 3 | GND | | GND |
| ⑥ | 1 | RV | O | RV for RF unit, TX : 15V |
| | 2 | ATV | O | ANT switching output for RF unit (TX : H) |
| ⑦ | 1 | AT0 | I | NC |
| | 2 | WRC | I | NC |
| ⑧ | 1 | GND | | GND |
| | 2 | VSF | I | Forward detect for SWR |
| | 3 | GND | | GND |
| | 4 | VSR | I | Reverse detect for SWR |
| | 5 | BTP | I | Protection input |
| | 6 | TV | O | TV for LPF unit, TX : 15V |
| | 7 | 28 | O | + 28V for LPF unit |
| | 8 | 21B | O | + 21V for LPF unit |
| ⑨ | 1 | GND | | GND |
| | 2 | TRQ | O | AT STBY signal for RF unit |
| ⑩ | 1 | 15B | O | + 15V for IF unit |
| | 2 | TBK | O | TBK for IF unit, TX : 15V |
| | 3 | RB | O | RB for IF unit, RX : 2.1V |
| | 4 | −12 | O | −12V for IF unit |
| ⑪ | 1 | −12 | O | −12V for SW unit |
| | 2 | TRQ | O | AT STBY signal for SW unit |
| | 3 | PC0 | I | TRQ-H : H, Normally : −12V |
| | 4 | PC1 | I | Power control VR |
| | 5 | PC2 | O | |
| ⑫ | 1 | ALC | O | ALC for IF unit |
| | 2 | GND | | GND |
| ⑬ | 1 | VCM | O | VC meter |
| | 2 | ALM | O | ALC meter |
| | 3 | ICM | O | IC meter |
| | 4 | GND | | GND |
| | 5 | SWR | O | SWR meter |
| | 6 | PWR | O | POWER meter |
| ⑭ | 1 | GND | | GND |
| | 2 | VX2 | I | VOX GAIN VR |
| ⑮ | 1 | NC | | NC |
| | 2 | ISW | O | SWR voltage for AT unit |
| | 3 | GND | | GND |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ⑯ | 1 | RRL | I | Connect to TV — When remote plug IN |
| | 2 | RLT | O | TX : GND, Normally : OPEN — When remote plug IN |
| | 3 | TV | O | TX : 15V |
| | 4 | RAL | I | ALC input |
| | 5 | XAL | I | ALC input — X. VERTER |
| | 6 | XRL | O | Relay control — X. VERTER |
| ⑰ | 1 | BLK | I | Dial click blanking pulse |
| | 2 | −C | I | −40V for −12V power supply |
| | 3 | 21B | O | + 21V for DC-DC unit |
| | 4 | BZ | I | Buzzer pulse |
| | 5 | DST | I | BAND data for TX.OFF |
| ⑱ | 1 | UL | O | PLL unlock signal for Digital B unit |
| | 2 | TR | O | TR (TX : 15V) for Digital B unit |
| ⑲ | 1 | NG1 | O | Noise blanker gate |
| | 2 | NBB | I | + B for noise blanker circuit |
| | 3 | GND | | GND |
| | 4 | NA | I | IF for noise blanker (8.83MHz) |
| ⑳ | 1 | 15B | I | + 15V |
| | 2 | NB2 | I | NB2 SW |
| | 3 | NB1 | I | NB1 SW |
| ㉑ | 1 | UL | I | Unlock signal (L : TX.OFF) |
| | 2 | 15A | O | + 15V for PLL unit |
| | 3 | 5 | O | + 5V for PLL unit |
| | 4 | GND | | GND |
| ㉒ | 1 | DLY | O | DLAY VR |
| | 2 | VXC | O | ANTI VOX VR |
| | 3 | V15 | O | + 15V for SW unit |
| ㉓ | 1 | GND | | GND |
| | 2 | 5CO | I | + 5V |
| ㉔ | 1 | NG2 | O | NB2 blanking signal |
| | 2 | GND | | GND |
| ㉕ | 1 | GND | | GND |
| | 2 | MON | I | TX IF for SSB, FSK, AM monitor (8.83MHz) |
| ㉖ | 1 | 15B | O | + 15V for SW unit |
| | 2 | MS | I | Power supply for monitor circuit |
| ㉗ | 1 | SS | I | SEND or PTT switch data (L : TX) |
| | 2 | FBK | I | CW mode FULL/SEMI SW FULL : 15V |
| | 3 | VS1 | I | AM, SSB mode VOX SW ON : 15V |
| | 4 | VS2 | I | CW mode VOX SW ON : 15V |
| ㉘ | 1 | MUT | O | SQL MUT signal (Muting : H) |
| | 2 | AMB | I | AM mode data, AM : 15V |
| | 3 | CWG | I | CW mode data, CW : 0V |
| | 4 | FMB | I | FM mode data, FM : 15V |
| | 5 | TRQ | O | AT STBY signal for IF unit |
| ㉙ | 1 | SQ1 | O | SQL VR output |
| | 2 | SQ2 | I | SQL VR input |
| ㉚ | 1 | GND | | GND |
| | 2 | CR0 | I | CAR0 for SSB, FSK, AM monitor (8.83MHz) |
| ㉛ | 1 | ANV | I | ANTI VOX VR |
| | 2 | GND | | GND |
| ㉜ | 1 | FMC | I | FM MIC GAIN VR |
| | 2 | MVG | | GND |
| ㉝ | 1 | FMM | O | FM Mic amp |
| | 2 | GND | | GND |
| ㉞ | 1 | FIN | I | FM IF input (455kHz) |
| | 2 | GND | | GND |
| ㉟ | 1 | CR4 | I | CAR4 for side tone (99.2kHz) |
| | 2 | GND | | GND |
| | 3 | GND | | GND |
| | 4 | CR3 | I | CAR3 for side tone (100kHz) |

# TS-940S TERMINAL FUNCTION

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ㊱ | 1 | SP1 | O | Audio signal for REMOTE 1pin |
| | 2 | GND | | GND |
| | 3 | GND | | GND |
| | 4 | SP2 | O | Audio signal for EXT. SP |
| | 5 | KEY | I | KEY UP : H, Normally : L |
| | 6 | STK | I | KEY DOWN : L, Normally : H |
| ㊲ | 1 | AV2 | I | AF GAIN VR |
| | 2 | AVG | | GND |
| ㊳ | 1 | SP2 | I | Audio signal from PHONE |
| | 2 | GND | | GND |
| | 3 | GND | | GND |
| | 4 | SP1 | O | Audio signal from PHONE |
| ㊴ | 1 | VO | I | VS-1 (option) voice signal |
| | 2 | GND | | GND |
| ㊵ | 1 | GND | | GND |
| | 2 | FMV | O | FM detector output |
| ㊶ | 1 | ICB | I | Detect terminal for IC meter |
| | 2 | ICA | I | Detect terminal for VC, IC meter |
| ㊷ | 1 | AR | O | ON AIR LED light on |
| | 2 | GND | | GND |
| ㊹ | 1 | 8V | O | + 8V for VS-1 (option) |
| | 2 | GND | | GND |
| | | SS | I | REMOTE 4 pin, EXT. STBY |
| **DIGITAL A UNIT (X54-1830-00)** | | | | |
| ① | 1 | LOCK | O | F. LOCK segment data |
| | 2 | SC | O | Scale display data |
| | 3 | G5 | O | Grid data |
| | 4 | G4 | O | |
| | 5 | G3 | O | |
| | 6 | G2 | O | |
| | 7 | G1 | O | |
| | 8 | G9 | O | |
| | 9 | G10 | O | |
| | 10 | G8 | O | |
| | 11 | G7 | O | |
| | 12 | G6 | O | |
| ② | 1 | B2 | O | Multiplex segment data |
| | 2 | B3 | O | |
| | 3 | B4 | O | |
| | 4 | B5 | O | |
| | 5 | B6 | O | |
| | 6 | B7 | O | |
| ③ | 1 | B1 | O | Segment data DP |
| | 2 | B0 | O | Segment data g |
| | 3 | C3 | O | Segment data P10 |
| | 4 | C2 | O | Segment data P9 |
| | 5 | C1 | O | Segment data P8 |
| | 6 | C0 | O | Segment data P7 |
| | 7 | C6 | O | Segment data control |
| | 8 | C7 | O | |
| ④ | 1 | LP2 | O | LPF BAND data |
| | 2 | LP1 | O | |
| | 3 | LP0 | O | |
| | 4 | WRC | O | NC |
| | 5 | WRC | O | AT BAND data |
| | 6 | AT0 | O | NC |
| | 7 | AT0 | O | AT BAND data |
| | 8 | AT1 | O | |
| | 9 | AT2 | O | |
| | 10 | AT3 | O | |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ⑤ | 1 | DA0 | O | PLL data for PLL, CAR unit |
| | 2 | DA1 | O | |
| | 3 | DA2 | O | |
| | 4 | PLD | O | PLL data for PLL unit IC17 |
| | 5 | PLE | O | Data latch for PLL unit IC17 |
| | 6 | CL3 | O | Clock for PLL unit IC17 |
| | 7 | CL2 | O | Clock for PLL unit IC8 |
| | 8 | CL1 | O | Clock for PLL unit IC9 |
| | 9 | CL0 | O | Clock for PLL unit IC19 |
| | 10 | DA3 | O | PLL data for PLL, CAR unit |
| | 11 | GND | | GND |
| ⑥ | 1 | SH | O | SLOPE HIGH cut |
| | 2 | SL | O | SLOPE LOW cut — Code select data |
| | 3 | VB | O | VBT |
| ⑦ | 1 | CL4 | O | PLL clock for CAR1 (455kHz) |
| | 2 | CL5 | O | PLL clock for CAR2 (9.285MHz) |
| ⑧ | 1 | BZ | O | Buzzer pulse |
| | 2 | DST | O | BAND data |
| | 3 | BLK | O | Dial click blanking pulse |
| ⑨ | 1 | DIM | I | DIM SW OFF: 0V |
| | 2 | SPL | O | SPLIT LED light on |
| | 3 | TX | O | STBY control |
| | 4 | VCL | O | Main VCO select signal |
| | 5 | VCM | O | |
| | 6 | MDD | O | MODE LED light ON |
| | 7 | MD1 | O | |
| | 8 | MD2 | O | |
| | 9 | WN | O | WIDE, NAR data, NAR : H |
| | 10 | GND | | GND |
| ⑩ | 1 | ATS | O | AT start pulse |
| | 2 | GND | | GND |
| ⑪ | 1 | RC | O | RIT CLEAR pulse |
| | 2 | CN | O | Multiplex control data for switches |
| | 3 | SL0 | O | Multiplex select data for switches |
| | 4 | SL1 | O | |
| | 5 | SL2 | O | |
| | 6 | SL3 | O | |
| ⑫ | 1 | GND | | GND |
| | 2 | 13 | I | Multiplex switch data |
| | 3 | 12 | I | |
| | 4 | 11 | I | |
| | 5 | 10 | I | |
| | 6 | 14 | I | |
| | 7 | 15 | I | |
| | 8 | 16 | I | |
| | 9 | 17 | I | |
| ⑬ | 1 | RB0 | O | RX BPF band data |
| | 2 | RB1 | O | |
| | 3 | RB2 | O | |
| | 4 | RB3 | O | |
| | 5 | HDL | O | HOLD LED light on |
| | 6 | PSL | O | PG.S LED light on |
| | 7 | MSL | O | M.S LED light on |
| ⑭ | 1 | SB1 | O | LCD display data |
| | 2 | SB2 | O | |
| | 3 | MRQ | O | Data clock for sub μ-processor |
| | 4 | SB3 | O | LCD display data |
| | 5 | SB0 | O | |
| | 6 | GND | | GND |
| ⑮ | 1 | GND | | GND |
| | 2 | 5DA | I | + 5V |
| | 3 | 10DA | I | + 10V |
| ⑯ | 1 | 5V | O | + 5V for DC-DC unit |
| | 2 | GND | | GND |
| | 3 | DIM | O | DIM data for DC-DC unit, DIM SW OFF : 0V |
| ⑰ | 1 | GND | | GND |
| | 2 | ENC | I | Main encoder pulse |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ⑱ | 1 | VDD | O | + 5V for photo coupler |
| | 2 | GND | | GND |
| | 3 | TXD | O | TX data |
| | 4 | RXD | I | RX data |
| | 5 | CTS | I | Clear to SEND |
| | 6 | RTS | O | Request to SEND |
| | | | | } ACC1 |
| ⑲ | 1 | CLK | O | Clock |
| | 2 | B | O | + 10V for interface |
| | 3 | RDY | I | RADY |
| | 4 | CD | O | Control data |
| | 5 | CS | O | Chip select |
| | 6 | R | O | Read |
| | 7 | WR | O | Write |
| | 8 | GND | | GND |
| | | | | } EXT Control board (option) |
| ⑳ | 1 | RES | O | Reset |
| | 2 | D0 | I/O | Data 0 |
| | 3 | D1 | I/O | Data 1 |
| | 4 | D2 | I/O | Data 2 |
| | 5 | D3 | I/O | Data 3 |
| | 6 | D4 | I/O | Data 4 |
| | 7 | D5 | I/O | Data 5 |
| | 8 | D6 | I/O | Data 6 |
| | 9 | D7 | I/O | Data 7 |
| | | | | } EXT control board (option) |

**CAR UNIT (X54-1840-00 : A/2)**

| | | | | |
|---|---|---|---|---|
| ① | 1 | 15V | I | + 15V |
| | 2 | 5V | I | + 5V |
| | 3 | UL1 | O | Unlock signal |
| | 4 | CL4 | I | PLL clock for CAR1 (455kHz) |
| | 5 | DA3 | I | } PLL data for CAR1, CAR2 |
| | 6 | DA2 | I | |
| | 7 | DA1 | I | |
| | 8 | DA0 | I | |
| | 9 | CL5 | I | PLL clock for CAR2 (9.285MHz) |
| | 10 | LSB | I | LSB, FLS : H } CAR1 f shift |
| | 11 | USB | I | USB, CW, AM, FM, TUNE : H |
| ② | 1 | GND | | GND |
| | 2 | CR2 | O | CAR2 for IF unit (455kHz) |
| | 3 | GND | | GND |
| | 4 | 117 | O | 117MHz for PLL unit |
| | 5 | GND | | GND |
| | 6 | 10 | I | 10MHz |
| | 7 | GND | | GND |
| | 8 | CR0 | O | CAR0 for SSB, FSK AM monitor (8.83MHz) |
| | 9 | GND | | GND |
| | 10 | CR0 | O | Carrier for TX, CW, FM (8.83MHz) |
| | 11 | GND | | GND |
| | 12 | CR1 | O | CAR1 for IF unit (455kHz) |

**DIGITAL B UNIT (X54-1840-00 : B/2)**

| | | | | |
|---|---|---|---|---|
| ① | 1 | GND | | GND |
| | 2 | ME1 | I | } Main encoder pulse input |
| | 3 | ME2 | I | |
| | 4 | 5V | O | + 5V for main encoder |
| ② | 1 | TRQ | I | AT STBY signal, Tuning : H |
| | 2 | AS1 | O | } ATT SW data |
| | 3 | AS2 | I | |
| | 4 | ATB | I | ATT-THRU : 21V |
| ③ | 1 | GND | | GND |
| | 2 | 17 | O | } Multiplex switch data |
| | 3 | 16 | O | |
| | 4 | 15 | O | |
| | 5 | 14 | O | |
| ④ | 1 | UL | I | Unlock signal |
| | 2 | TR | I | TX : 15V |
| ⑤ | 1 | MU | I | MIC UP |
| | 2 | MD | I | MIC DOWN |
| | 3 | 8C | O | + 8V for MIC connector |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ⑥ | 1 | M►V | I | M ► VFO KEY |
| | 2 | MIN | I | M. IN KEY |
| | 3 | LOK | I | F. LOCK KEY |
| | 4 | SPT | I | SPLIT KEY |
| | 5 | A/B | I | A/B KEY |
| | 6 | BD | I | BAND DOWN KEY |
| | 7 | BU | I | BAND UP KEY |
| | 8 | ATT | I | ATT KEY |
| | 9 | GND | | GND |
| | | | | } SW ON : L |
| ⑦ | 1 | 10 | I | 10Hz digit display data |
| | 2 | 100 | I | 1MHz 100kHz switching signal |
| | 3 | MB0 | I | Memory bank SW, 2, 3 : H |
| | 4 | MB1 | I | Memory bank SW, 1, 3 : H |
| ⑧ | 1 | B3 | I | } 10 KEY (BAND) matrix data |
| | 2 | B2 | I | |
| | 3 | B1 | I | |
| | 4 | B0 | I | |
| | 5 | M/V | I | M/V KEY |
| | 6 | TFS | I | TFS KEY |
| | 7 | A=B | I | A=B KEY |
| | 8 | VRC | I | VOICE KEY |
| | | | | } KEY ON : L |
| ⑨ | 1 | VB0 | I | Bit 0 |
| | 2 | VB1 | I | Bit 1 |
| | 3 | VB2 | I | Bit 2 |
| | 4 | VB3 | I | Bit 3 |
| | 5 | VB4 | I | Bit 4 |
| | | | | } Code data for VBT, SLOPE TUNE |
| ⑩ | 1 | ENT | I | ENT KEY |
| | 2 | MCE | I | MCE KEY |
| | | | | } KEY ON : L |
| | 3 | NRQ | O | NRQ output for keyboard ass'y |
| | 4 | WIDE | I | NAR/WIDE SW, WIDE : 15V |
| | 5 | M2 | I | } MODE KEY matrix data |
| | 6 | M1 | I | |
| | 7 | M0 | I | |
| | 8 | RCL | I | RIT CLEAR KEY |
| | 9 | XIT | I | XIT KEY |
| | 10 | RIT | I | HOLD KEY |
| | 11 | HLD | I | HOLD KEY |
| | 12 | PSC | I | PG.S KEY |
| | 13 | MS | I | MS KEY |
| | | | | } KEY ON : L |
| ⑪ | 1 | RC | I | RIT CLEAR pulse |
| | 2 | CN | I | Multiplex control data for switches |
| | 3 | 13 | O | } Multiplex switch data |
| | 4 | 12 | O | |
| | 5 | 11 | O | |
| | 6 | 10 | O | |
| | 7 | SL3 | I | } Multiplex select data for switches |
| | 8 | SL2 | I | |
| | 9 | SL1 | I | |
| | 10 | SL0 | I | |
| ⑫ | 1 | GND | | GND |
| | 2 | RE2 | I | RIT encoder pulse 2 |
| | 3 | RE1 | I | RIT encoder pulse 1 |
| | 4 | 5V | O | + 5V for RIT encoder |
| ⑬ | 1 | HS | I | LCD DATA accept message |
| | 2 | 8B | I | + 8V for MIC connector |
| | 3 | 5C | I | + 5V |
| | 4 | GND | | GND |
| ⑭ | 1 | GND | | GND |
| | 2 | ENC | O | Main encoder pulse output |

**DIGITAL C UNIT (X54-1850-00)**

| | | | | |
|---|---|---|---|---|
| ① | 1 | B2 | I | } Multiplex segment data |
| | 2 | B3 | I | |
| | 3 | B4 | I | |
| | 4 | B5 | I | |
| | 5 | B6 | I | |
| | 6 | B7 | I | |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ② | 1 | G1 | I | } Grid data |
| | 2 | G2 | I | |
| | 3 | G3 | I | |
| | 4 | G4 | I | |
| | 5 | SC | I | Scale data |
| ③ | 1 | 5V | I | + 5V |
| | 2 | GND | | GND |
| | 3 | HV | I | –40V for drive display tube |
| ④ | 1 | B0 | I | Segment data DP |
| | 2 | B1 | I | Segment data g |
| | 3 | C0 | I | Segment data P10 |
| | 4 | C1 | I | Segment data P9 |
| | 5 | C2 | I | Segment data P8 |
| | 6 | C3 | I | Segment data P7 |
| | 7 | C6 | I | } Segment control data |
| | 8 | C7 | I | |
| ⑤ | 1 | G5 | I | } Grid data |
| | 2 | G6 | I | |
| | 3 | G7 | I | |
| | 4 | G8 | I | |
| | 5 | G9 | I | |
| | 6 | G10 | I | |
| | 7 | LOCK | I | Segment data F. LOCK |
| ⑥ | 1 | FH | I | } Filament voltage for display |
| | 2 | FG | I | |
| ⑦ | 1 | f | O | Segment data f |
| | 2 | LOCK | O | LOCK display data |
| | 3 | FH | O | Heater for display tube |
| | 4 | VFO A | O | VFO A display data |
| | 5 | VFO B | O | VFO B display data |
| | 6 | G10 | O | Grid data No. 10 |
| | 7 | d | O | Segment data d |
| | 8 | e | O | Segment data e |
| ⑧ | 1 | G9 | O | Grid data No. 9 |
| | 2 | G8 | O | Grid data No. 8 |
| | 3 | P1 | O | } Analog digit data |
| | 4 | P2 | O | |
| | 5 | G7 | O | Grid data No. 7 |
| | 6 | P3 | O | } Analog digit data |
| | 7 | P4 | O | |
| | 8 | G6 | O | Grid data No. 6 |
| | 9 | P10 | O | Analog digit data |
| | 10 | G5 | O | Grid data No. 5 |
| | 11 | P9 | O | Analog digit data |
| | 12 | MEMO | O | MEMO display data |
| ⑨ | 1 | g | O | Segment data g |
| | 2 | c | O | Segment data c |
| | 3 | G4 | O | Grid data No. 4 |
| | 4 | P8 | O | Analog digit data |
| | 5 | G3 | O | Grid data No. 3 |
| | 6 | P7 | O | } Analog digit data |
| | 7 | P6 | O | |
| | 8 | G2 | O | Grid data No. 2 |
| | 9 | P5 | O | Analog digit data |
| | 10 | G1 | O | Grid data No. 1 |
| | 11 | b | O | Segment data b |
| | 12 | – | O | – (minus) display data |
| ⑩ | 1 | SC | O | Scale display data |
| | 2 | a | O | Segment data a |
| | 3 | DP | O | Dot display data |
| | 4 | FG | O | Heater for display tube |
| | 5 | RIT | O | RIT display data |
| | 6 | XIT | O | XIT display data |

**AT UNIT (B) (X57-1130-00)**

| | | | | |
|---|---|---|---|---|
| ① | 1 | GND | | GND |
| | 2 | ATS | I | AT start pulse |

| Terminal No. | | Name | I/O | Terminal Function |
|---|---|---|---|---|
| ② | 1 | 15B | I | + 15V |
| | 2 | TRQ | O | AT STBY signal for Control unit |
| | 3 | TV | I | TX : 15V |
| ③ | 1 | TRQ | O | AT STBY signal for Digital B unit |
| | 2 | AS1 | I | } ATT KEY signal (ATT ON : L) |
| | 3 | AS2 | O | } confirmation signal for AT installed. |
| | 4 | ATB | O | AT THRU : 21V |
| ④ | 1 | ATB | I | AT THRU : 21V |
| | 2 | TRQ | O | AT STBY signal for MB control |
| | 3 | TV | O | TX : 15V |
| | 4 | MB | I | Tuning : 14V |
| ⑤ | 1 | GND | | GND |
| | 2 | 10 | O | + 10V |
| | 3 | 5 | O | + 5V |
| | 4 | 14 | O | + 14V |
| | 5 | 21B | O | + 21V |
| ⑥ | 1 | 28 | | NC |
| | 2 | 21B | I | + 21V |
| ⑦ | 1 | ATV | O | TX : 15V |
| | 2 | TNQ | O | AT STBY signal for SW unit (L) |

**AT UNIT (B) (X57-1130-00)**

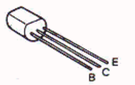
| | | | | |
|---|---|---|---|---|
| ⑧ | 1 | ATH | O | AT LED anode |
| | 2 | ATL | I | AT LED cathode |
| ⑨ | 1 | ATB | I | AT THRU : 21V |
| | 2 | TRQ | I | AT STBY signal for MB control |
| | 3 | TV | I | TX : 15V |
| | 4 | MB | O | Tuning : 14V |
| ⑩ | 1 | MB | O | Tuning : 14V |
| | 2 | GND | | GND |
| | 3 | 21B | O | + 21V for AT unit (C) |
| ⑪ | 1 | ATI | I | AT IN : 15V |
| | 2 | LED | O | TUNE LED light on |
| ⑫ | 1 | 21B | I | + 21V |
| | 2 | 5 | I | + 5V |
| | 3 | 10 | I | + 10V |
| | 4 | 14 | I | + 14V |
| | 5 | GND | | GND |
| ⑬ | 1 | GND | | GND |
| | 2 | ISW | I | SWR level |
| ⑭ | 1 | M1– | O | } Tuning motor control |
| | 2 | M1+ | O | |
| | 3 | M2– | O | |
| | 4 | M2+ | O | |

**AT UNIT (C)**

| | | | | |
|---|---|---|---|---|
| ⑮ | 1 | WRC | I | } AT BAND data |
| | 2 | AT0 | I | |
| | 3 | AT1 | I | |
| | 4 | AT2 | I | |
| | 5 | AT3 | I | |
| ⑯ | 1 | 21B | I | + 21V |
| | 2 | GND | | GND |
| | 3 | MB | I | Tuning : H |
| ⑰ | 1 | M1– | O | } Magnetic brake relay terminal for AT tune finish |
| | 2 | M1+ | O | |
| | 3 | M2– | O | |
| | 4 | M2+ | O | |

# TS-940S PC BOARD VIEWS

2SC2053



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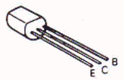
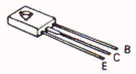
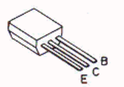
2SC1959
2SC1973



2SC496



2SA1048
2SC2458
2SC2668



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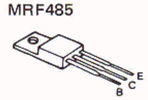
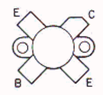
2SD880
MRF485



MRF422



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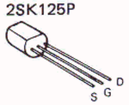
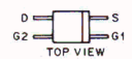
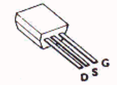
2SK125P



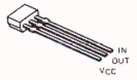
3SK73



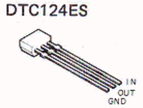

2SK192A



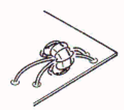
DTA143XS



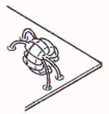

DTC124ES




LPF unit
[Attachment method
of L15]

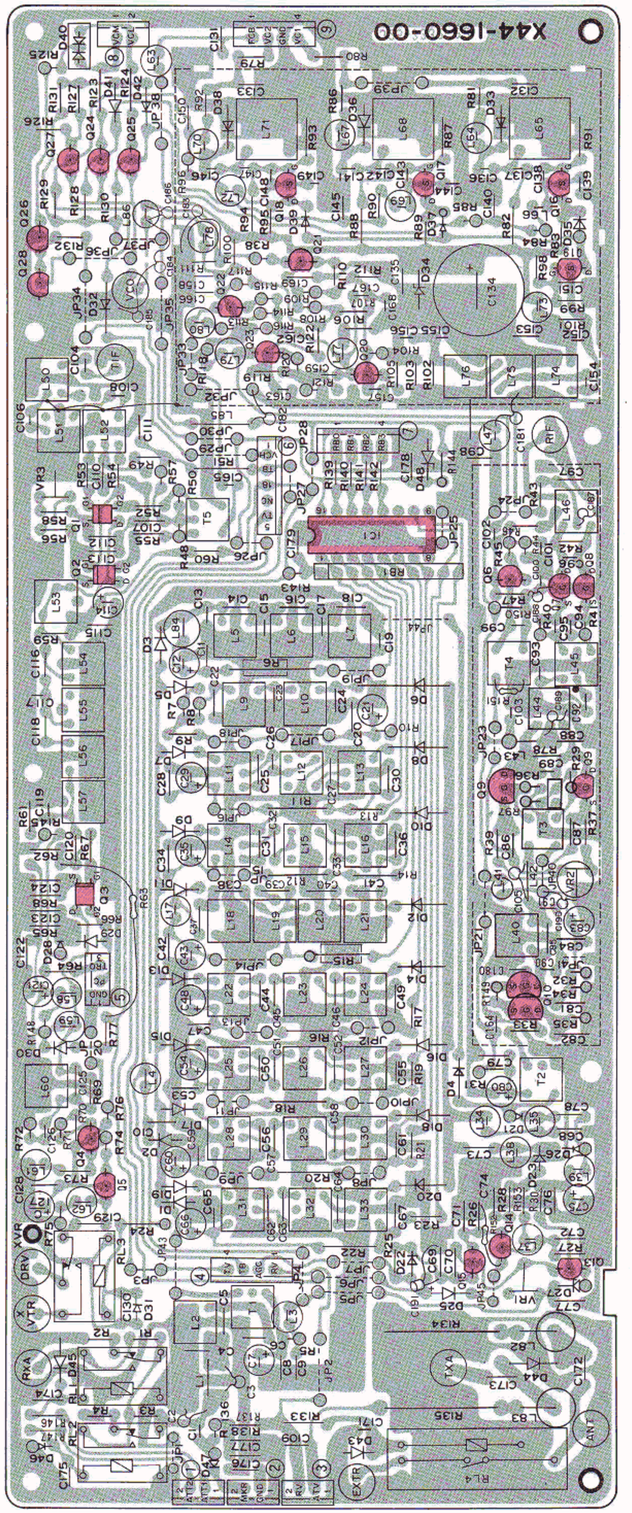


LPF unit
[Attachment method
of L16]

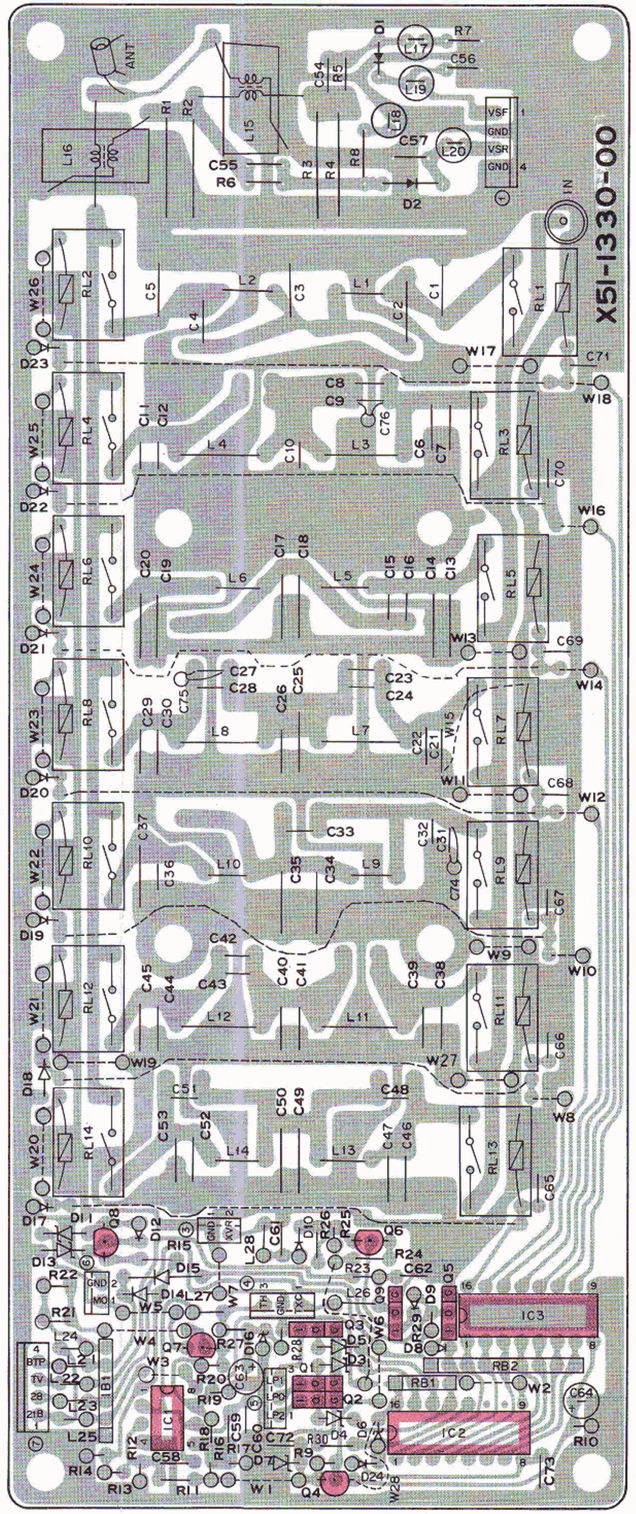


100W FINAL unit
[Attachment method
of R35 and L3]

RF UNIT (X44-1660-00) Component side view

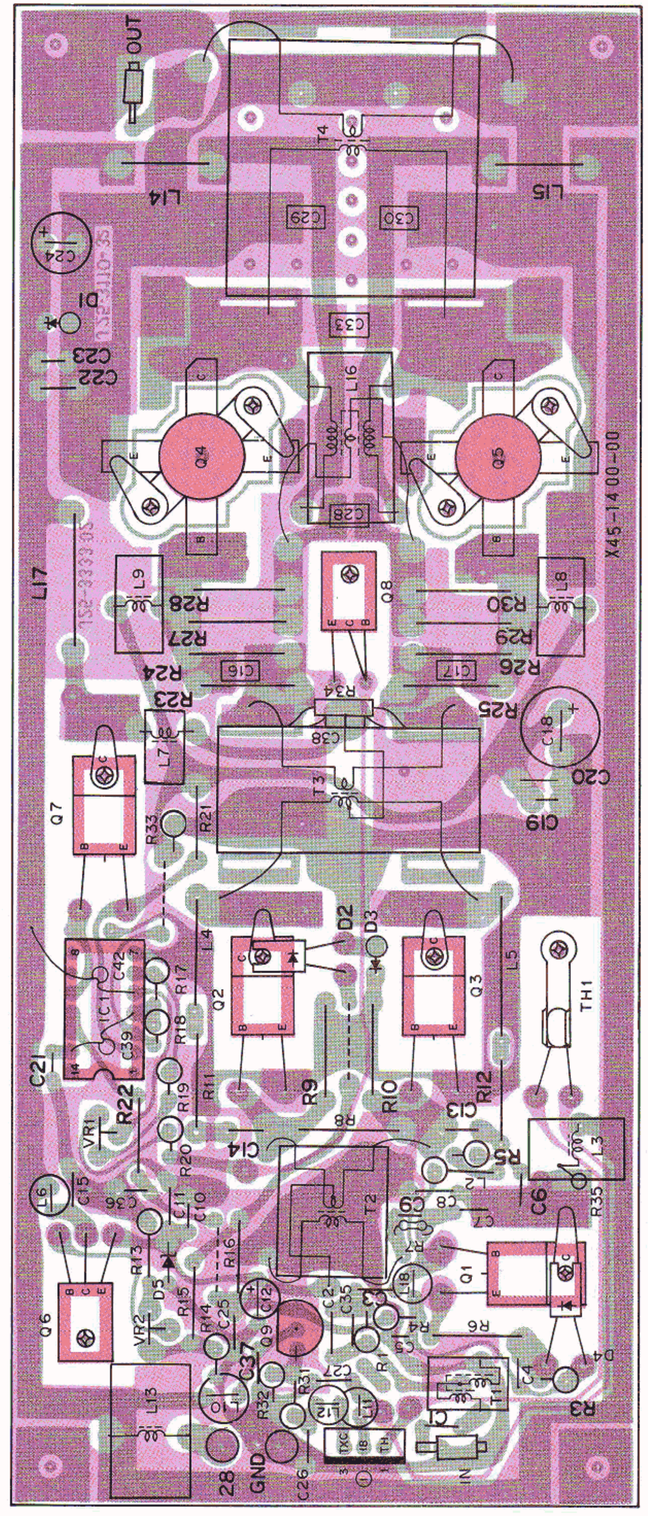



LPF UNIT (X51-1330-00) Component side view




Component side  Foil side

100W FINAL UNIT (X45-1400-00) Component side view

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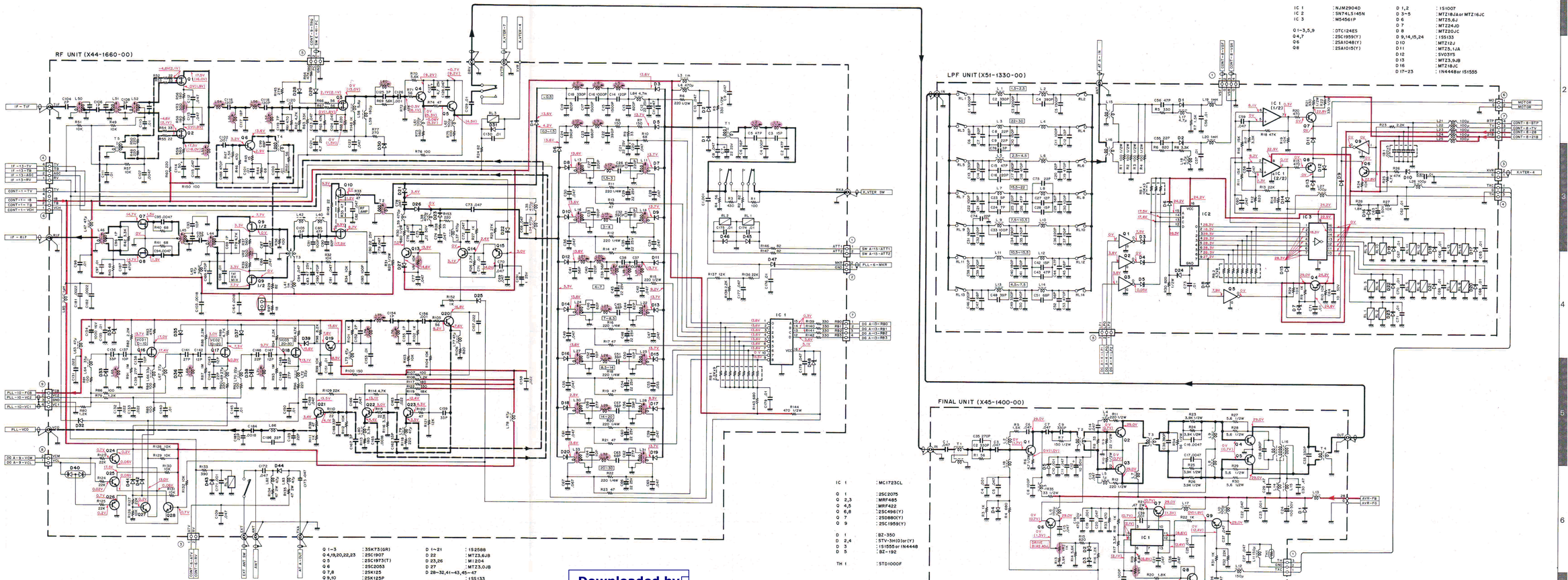
RadioAmateur.EU

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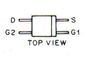
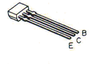
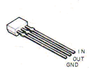
RadioAmateur.EU

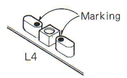
# TS-940S CIRCUIT DIAGRAM







[Attachment method of XF 1-A, B]

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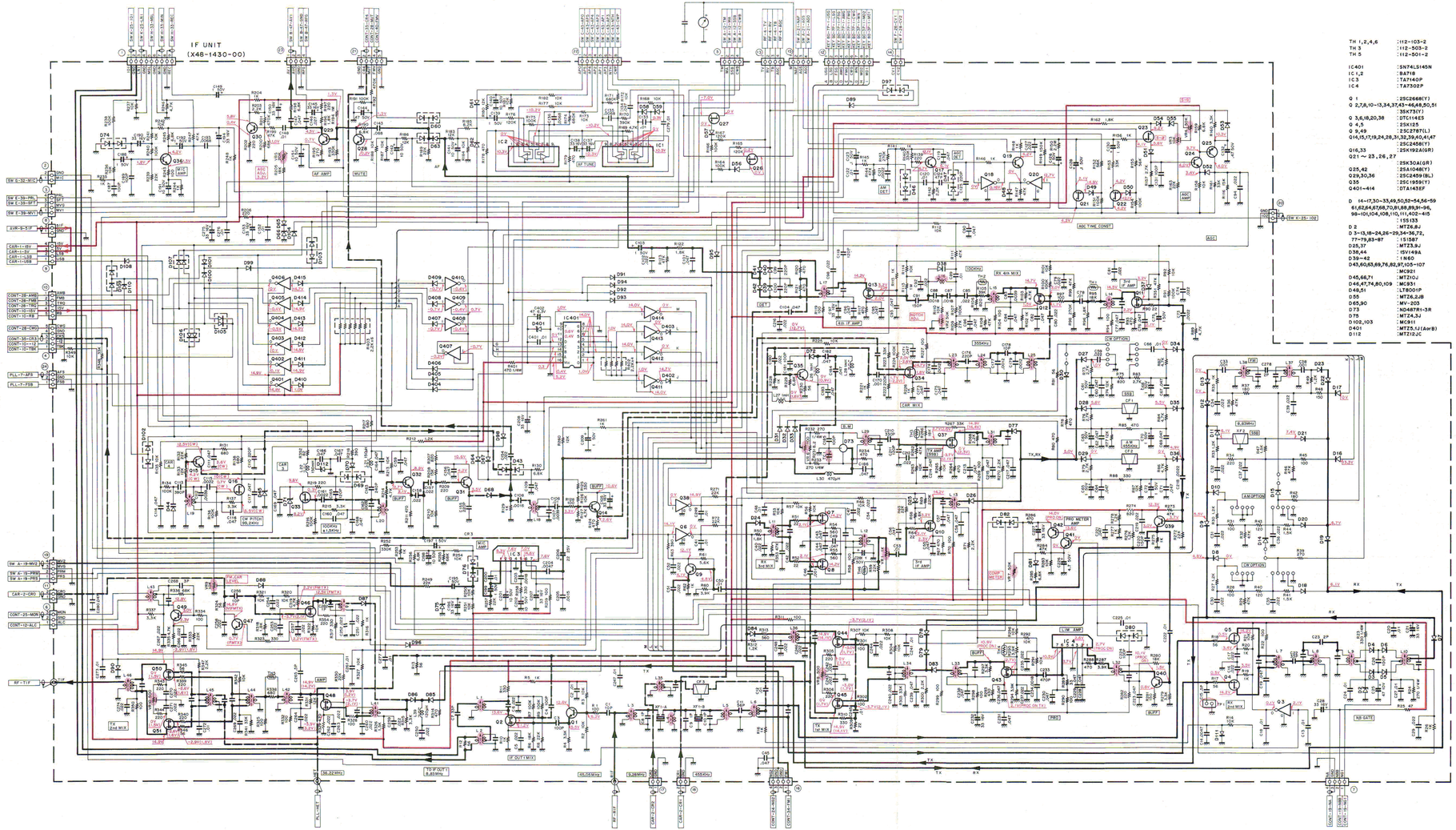
RadioAmateur.EU



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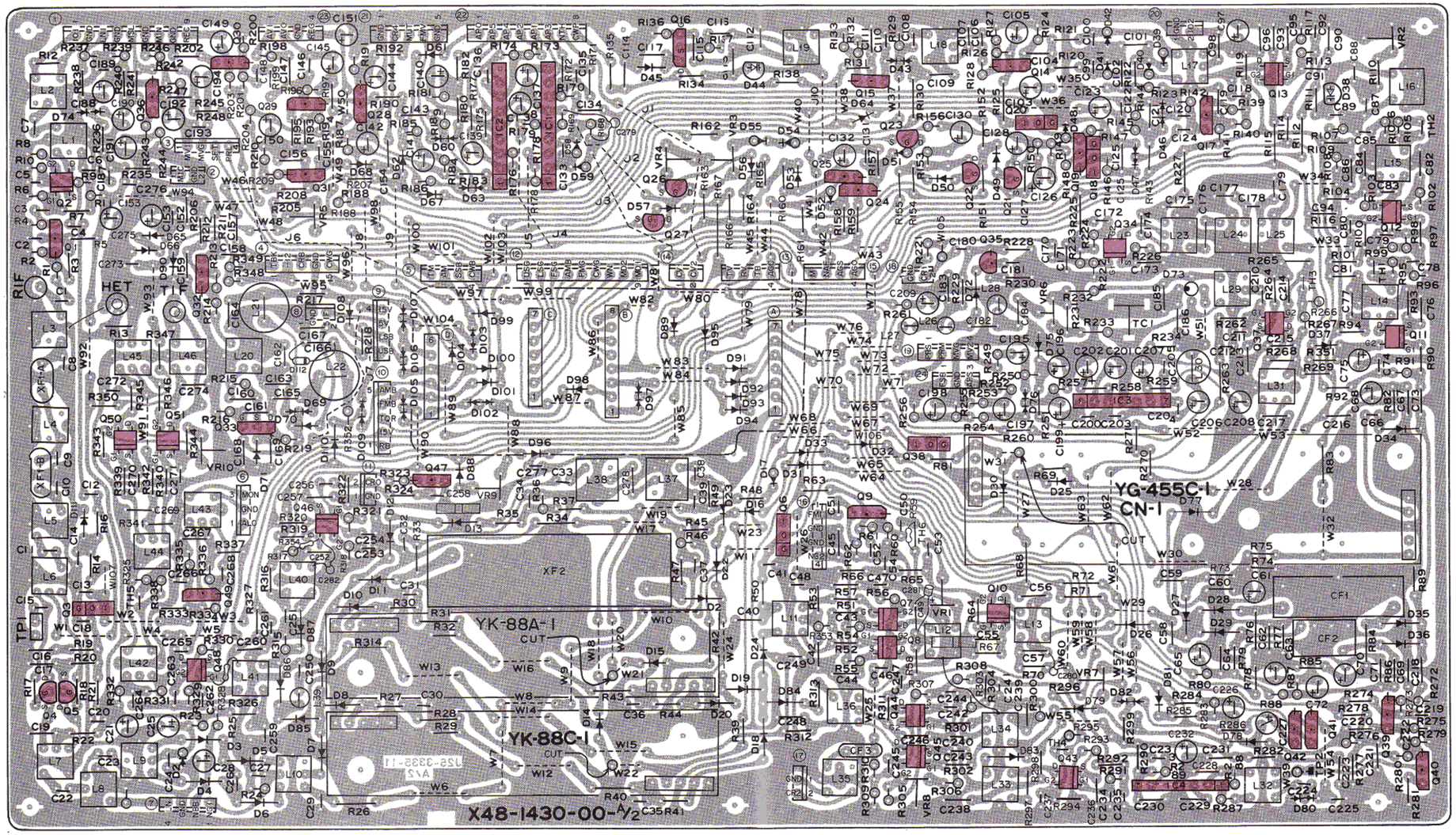
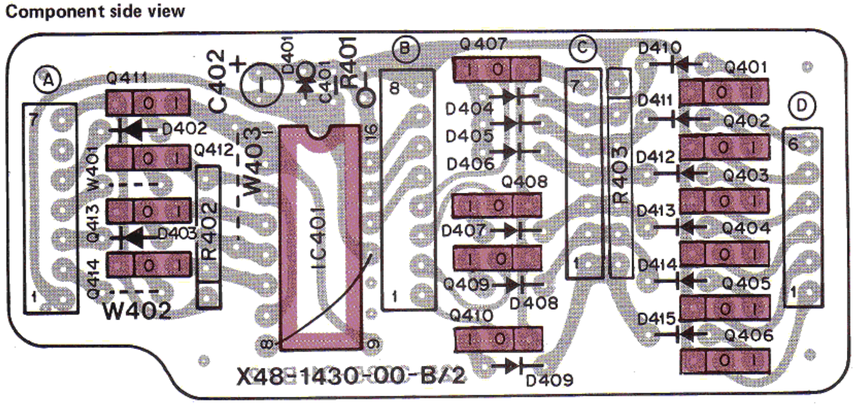
RadioAmateur.EU

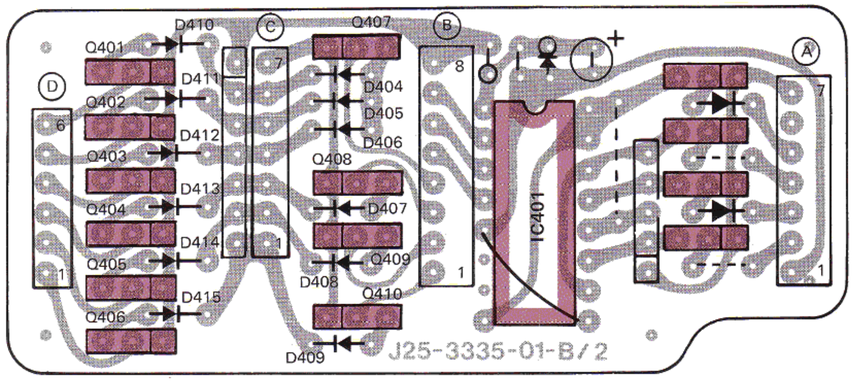
IF UNIT (X48-1430-00) Component side view




Component side view




Foil side view



# TS-940S PC BOARD VIEW

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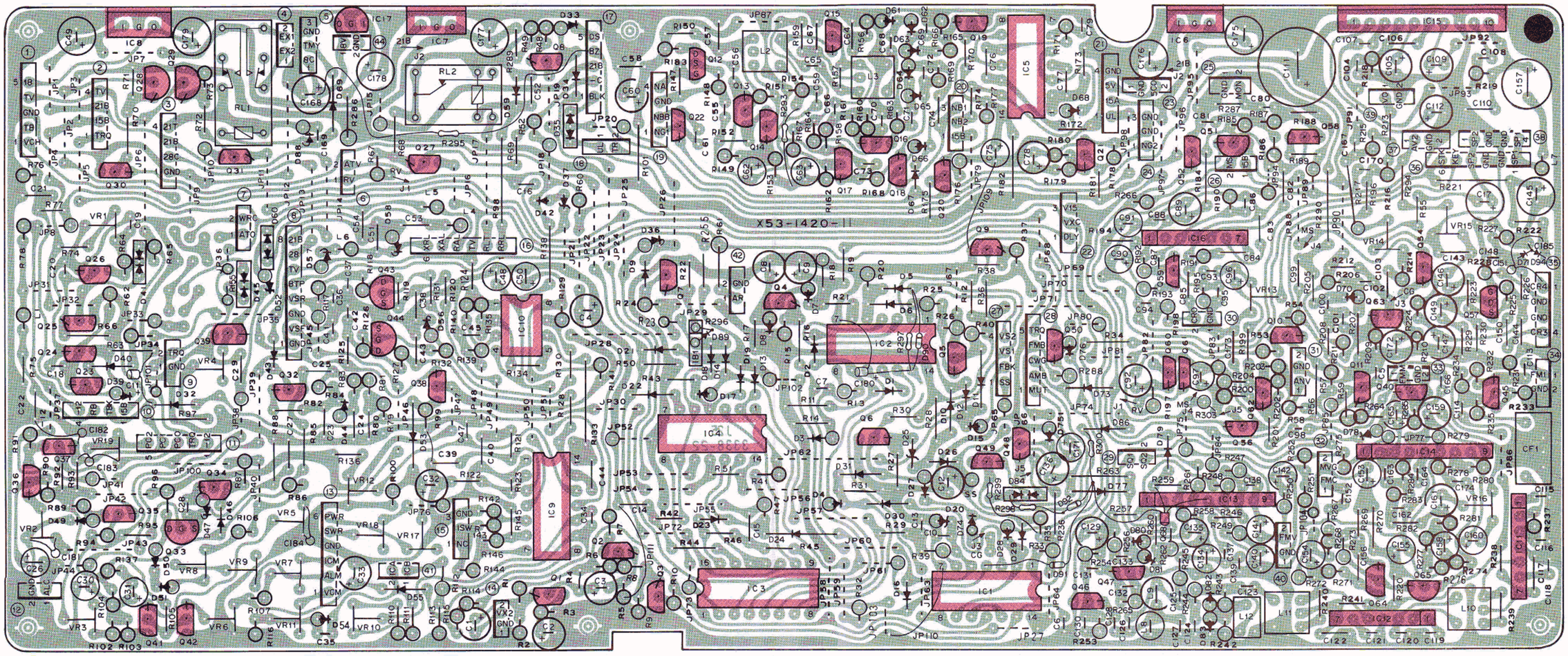
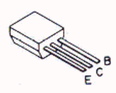
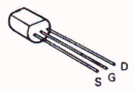
CONTROL UNIT (X53-1420-11) Component side view



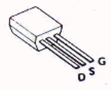

2SA1048
2SA984K
2SC2458
2SC2459



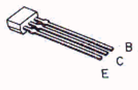

2SK30A



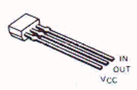

2SK192A



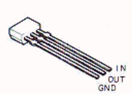

2SC2787



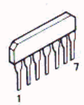

DTA143XS



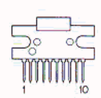

DTC124ES
DTC144WS



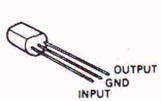

μPC1037H
μPC577H



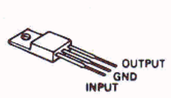

HA1368



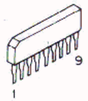

TA78L008AP



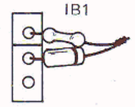

μA7818UC
μPC7815H



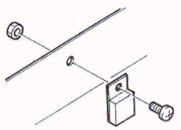

NJM4558S



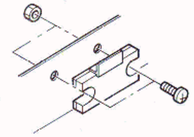

[Attachment method of R296, D89]




[Attachment method of IC6–7]



[Attachment method of IC15]



# CIRCUIT DIAGRAM TS-940S

| | |
|---|---|
| Q 1 | : 2SC2459(BL) |
| Q 2,3,5~11,17~21,24,26,32,34~38,41,42,46, 47,63 | : 2SC2458(Y) |
| Q 4,23,25,27,28,59 | : 2SA1048(Y) |
| Q 12,57 | : 2SK192A(GR)XJ |
| Q 13~16,45,58 | : 2SC2787(L) |
| Q 22,51,54 | : DTA143XS |
| Q 28,29 | : 2SA984K(E) |
| Q 30,31,40,52 | : DTC144WS |
| Q 33,43,44 | : 2SK30A(C) |
| Q 39,48~50,56,60,61, 68 | : DTC124ES |
| Q 62,64,65 | : 2SC2459(BL) |

| | |
|---|---|
| IC 1 | : TC4001BP |
| IC 2,5 | : TC4011BP |
| IC 3 | : TC4049BP |
| IC 4 | : TC4073BP |
| IC 6,7 | : μPC7815H |
| IC 8 | : UA7818UC |
| IC 9 | : MB3614 |
| IC 10 | : NJM2903D |
| IC 11,12 | : μPC577H |
| IC 13,14 | : NJM4558S |
| IC 15 | : HA1368 |
| IC 16 | : μPC1037H |
| IC 17 | : TA78L008AP |

| | |
|---|---|
| D 1~19,21~24,26~34,36,39,40,43,44,46,50,53,56, 58,59,66~70,73~77,79~81,85,86,88~92 | : 1SS133 |
| D 20 | : MTZ12JC |
| D 25 | : MTZ9.1JC |
| D 35,60 | : MC911 |
| D 37 | : MTZ10JC |
| D 41,45,84 | : MC921 |
| D 42 | : MV-203 |
| D 47 | : MTZ3.6JB |
| D 49,63 | : LT8001P |
| D 50 | : MTZ11JC |
| D 51 | : MTZ5.6JA |
| D 52 | : MTZ12J |
| D 54 | : MTZ20JC |

| | |
|---|---|
| D 55 | : 1SS99 |
| D 57 | : SV03YS |
| D 61,62,64,65,78,82,83 | : 1N60 |
| D 71,94 | : 1S1587 |

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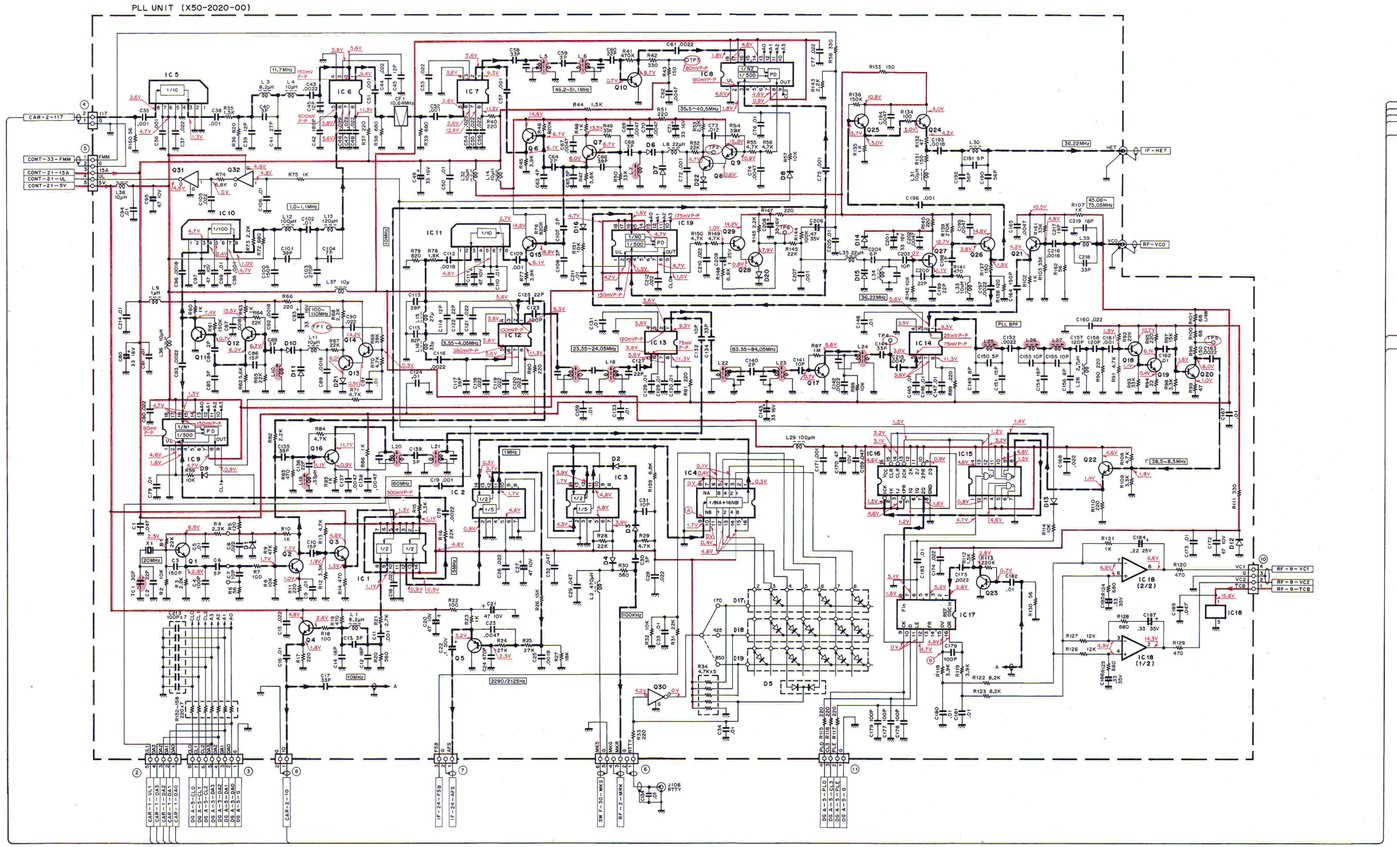
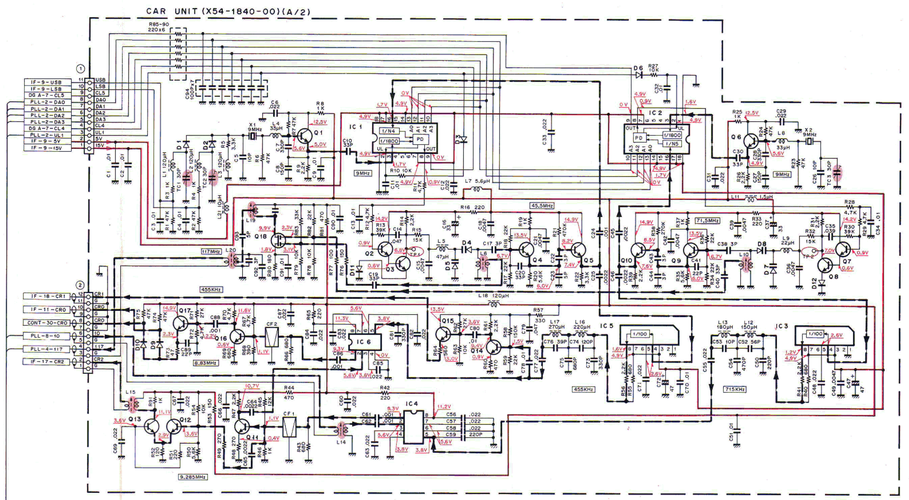
# TS-940S CIRCUIT DIAGRAM




| | | | | | |
|---|---|---|---|---|---|
| IC 1 | : SN74LS73AN | Q 1,6,7,10-15,17-19,21-23, | | D 1,14 | : MTZ12J |
| IC 2,3 | : SN74LS90N | 25,26 | : 2SC2668(Y) | D 2-4,8,9,13,16 | : 1S5133 |
| IC 4 | : MC14569BCP | Q 2-4,16 | : 2SC2787(L) | D 5 | : MC921 |
| IC 5,11 | : HD10551 | Q 5 | : 2SA1115(E) | D 6,7,10,11,15 | : 1SV123 |
| IC 6,7,12-14 | : SN16913P | Q 8,9,13,14 | : 2SA1313(B) | D 12 | : MTZ5.1J(A,B) |
| IC 8,9,19 | : MN6147 | Q 20,24 | : 2SC1907 | D 17 | : R90-0583-05 |
| IC 10 | : M54459L | Q 27 | : 2SK192A(GR)※J | D 18 | : R90-0582-05 |
| IC 15 | : SN74S10N | Q 28,29 | : 2SC2459(BL) | D 19 | : R90-0581-05 |
| IC 16 | : SN74S112N | Q 30,31 | : DTC124ES | D 20,21,22 | : MV-203 |
| IC 17 | : MC14515BP | Q 32 | : DTA124ES | | |
| IC 18 | : BA718 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| IC 1,2 | : MN6147 | D 1-3,6,9,10 | : 1S1587 | | |
| IC 3,5 | : M54459L | D 4,5,7,8 | : 1SV123 | | |
| IC 4,6 | : SN16913P | D 11,12 | : MV-203 | | |
| Q 1,6,11,16 | : 2SC2787(L) | | | | |
| Q 2,3,7,8 | : 2SC3113(B) | | | | |
| Q 4,5,9,10 | : 2SC2668(Y) | | | | |
| Q 12-15,17 | : 2SC2458(Y) | | | | |
| Q 18 | : 3SK73(GR) | | | | |

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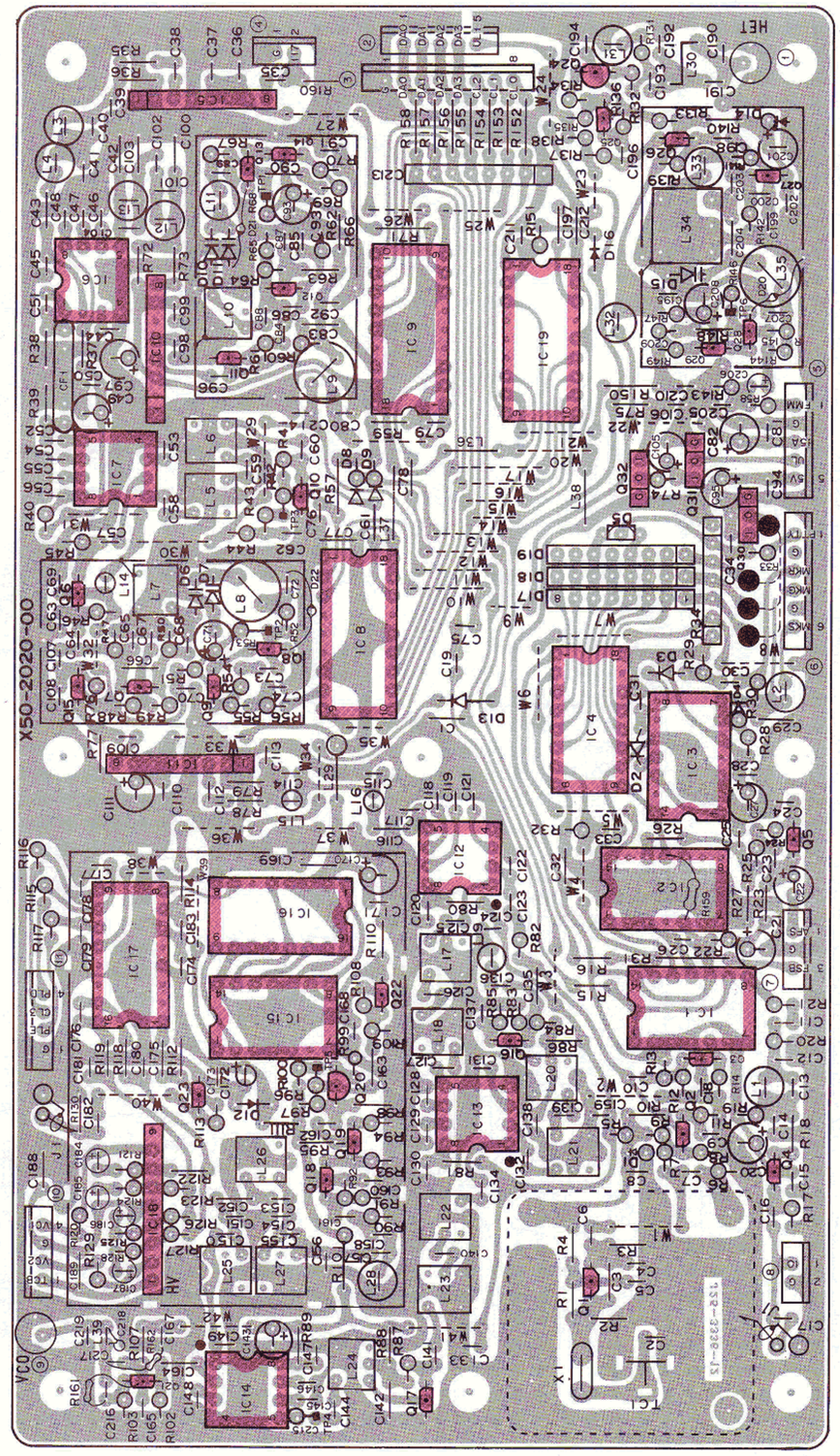
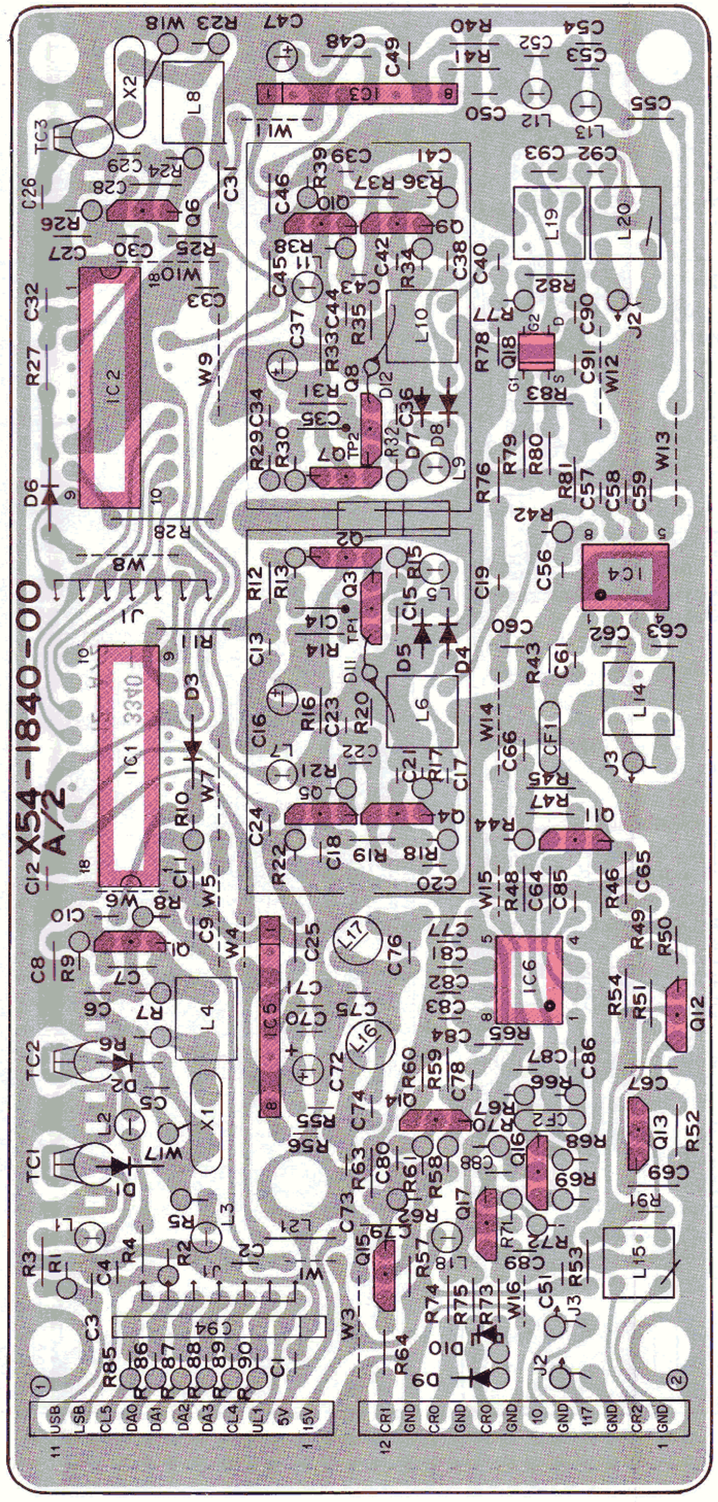
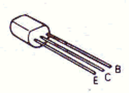
PLL UNIT (X50-2020-00) Component side view



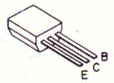

CAR UNIT (X54-1840-00) (A/2) Component side view



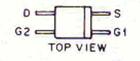

2SC1907



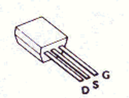
2SC2458
2SC2459
2SC2668
2SC3113



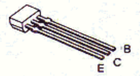
3SK73



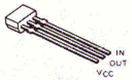

2SK192A



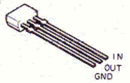
2SC2787



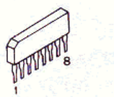
DTA124ES



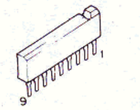

DTC124ES



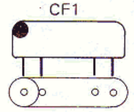

HD10551
M54459L



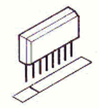
BA718



PLL unit
[Attachment direction of CF1]




CAR unit
[Attachment direction of IC3–5]



# CIRCUIT DIAGRAM TS-940S

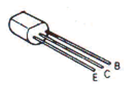
AT UNIT (X57-1130-00) (A/3)

AT UNIT (X57-1130-00) (B/3)

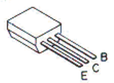
AT UNIT (X57-1130-00) (C/3)

| | | | | | |
|---|---|---|---|---|---|
| IC 101 | : HD10116 | Q 101,102,123 | : 2SA1048(Y) | D 101,102 | : 1N60 |
| IC 102 | : HD10131 | Q 103,108,110,115 | : 2SA950(Y) | D 103~106 | : 1SS99 |
| IC 103 | : HD10125 | Q 105,106,112,113 | : 2SC2120(Y) | D 112 | : 1N4448 |
| IC 104 | : NJM2901 | Q 118 | : 2SA966(O) | D 107~111,113,114, 116~118 | : 1SS133 |
| IC 105 | : NJM2904D | Q 119 | : 2SA984K(E) | | |
| IC 106 | : NE555P | Q 104,107,109,111,114, 117,120,121 | : 2SC2458(Y) | D 115 | : MTZ20J |
| IC 201 | : μPC7805H | Q 116,122,124~126 | : DTC124ES | D 119,201,202,210 | : LT8001P |
| IC 202 | : μPC78L08A | | | D 203~206,208,209 | : 1SS133 |
| IC 203 | : μPC7812H | Q 201 | : 2SA1015(Y) | D 207 | : MTZ10J(A,B) |
| IC 204 | : NE556N | Q 202,203 | : DTC124ES | D 211 | : MTZ11JC |
| IC 205 | : TC4027BP | | | | |
| IC 206 | : TC4011BP | Q 1~6 | : 2SA1015(Y) | D 1~8 | : 1N4448 |
| IC 207 | : TC4001BP | Q 9~13 | : DTC124ES | D 9,15~26 | : 1SS133 |
| IC 208 | : MC14077BCP | Q 7 | : DTC114ES | D 10 | : MTZ5.6JB |
| | | | | D 11~14 | : MTZ10J(A,B) |
| IC 1 | : SN74LS145N | | | D 27 | : MTZ16J(A,B) |

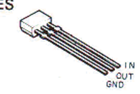
2SA1015
2SA950
2SA966
2SA984K
2SC2120



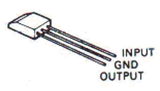

2SA1048
2SC2458



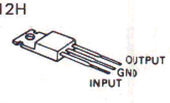

DTC114ES
DTC124ES



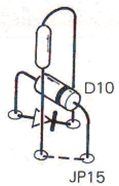

μPC78L08A




μPC7805H
μPC7812H




[Attachment method of JP15, D10]

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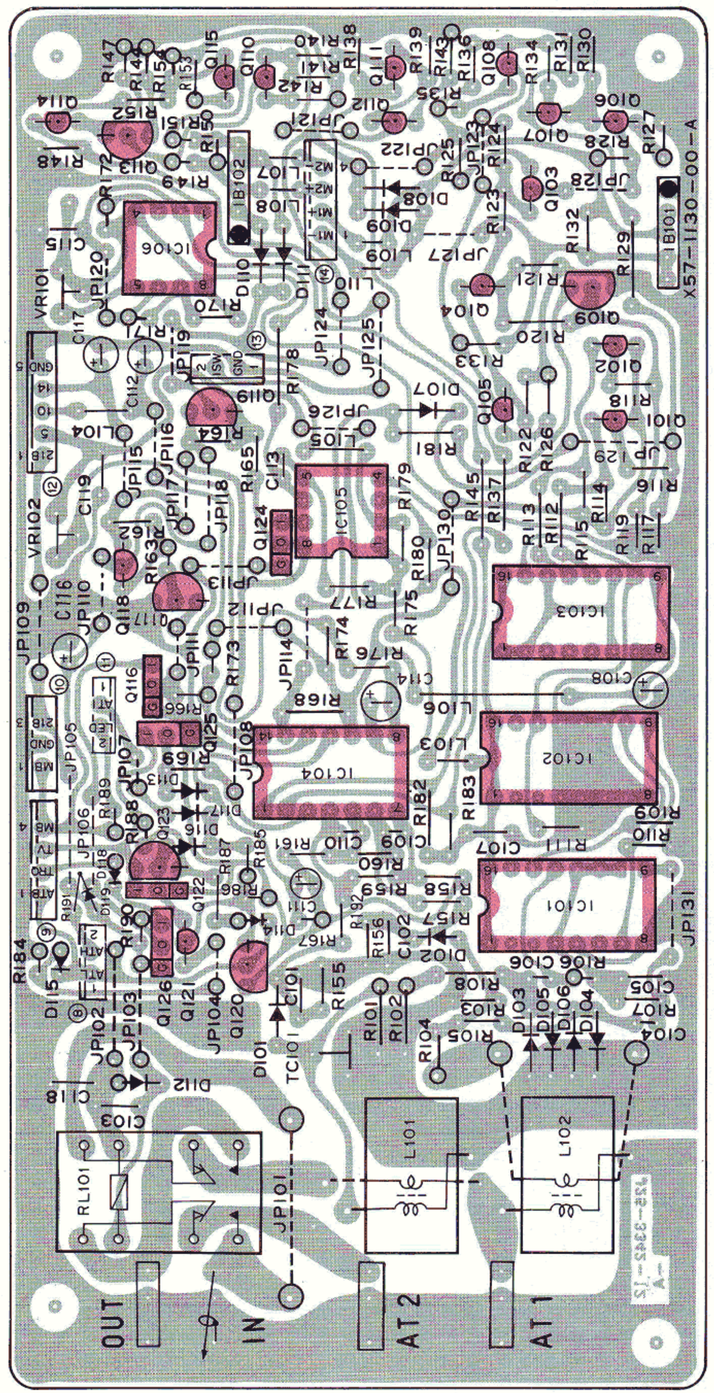
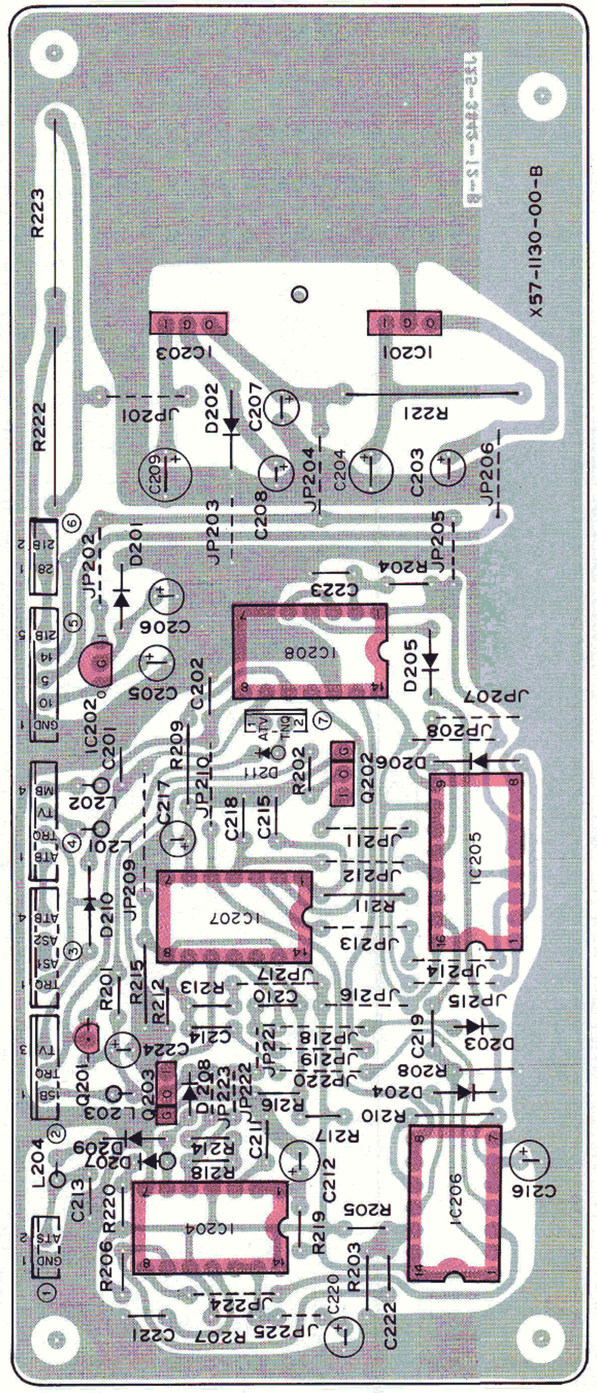
# TS-940S PC BOARD VIEWS

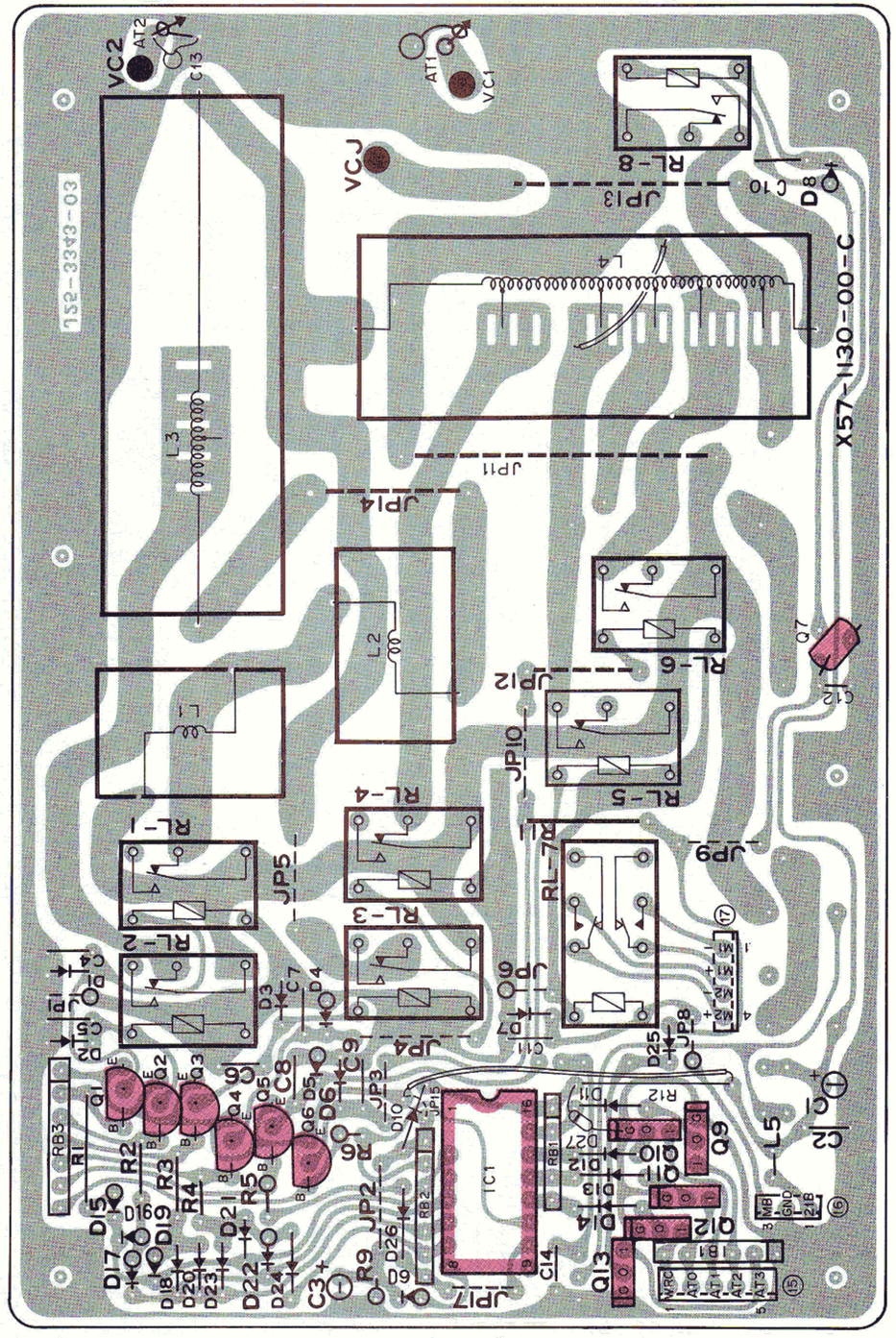
AT UNIT (A) (X57-1130-00) Component side view




AT UNIT (B) (X57-1130-00) Component side view



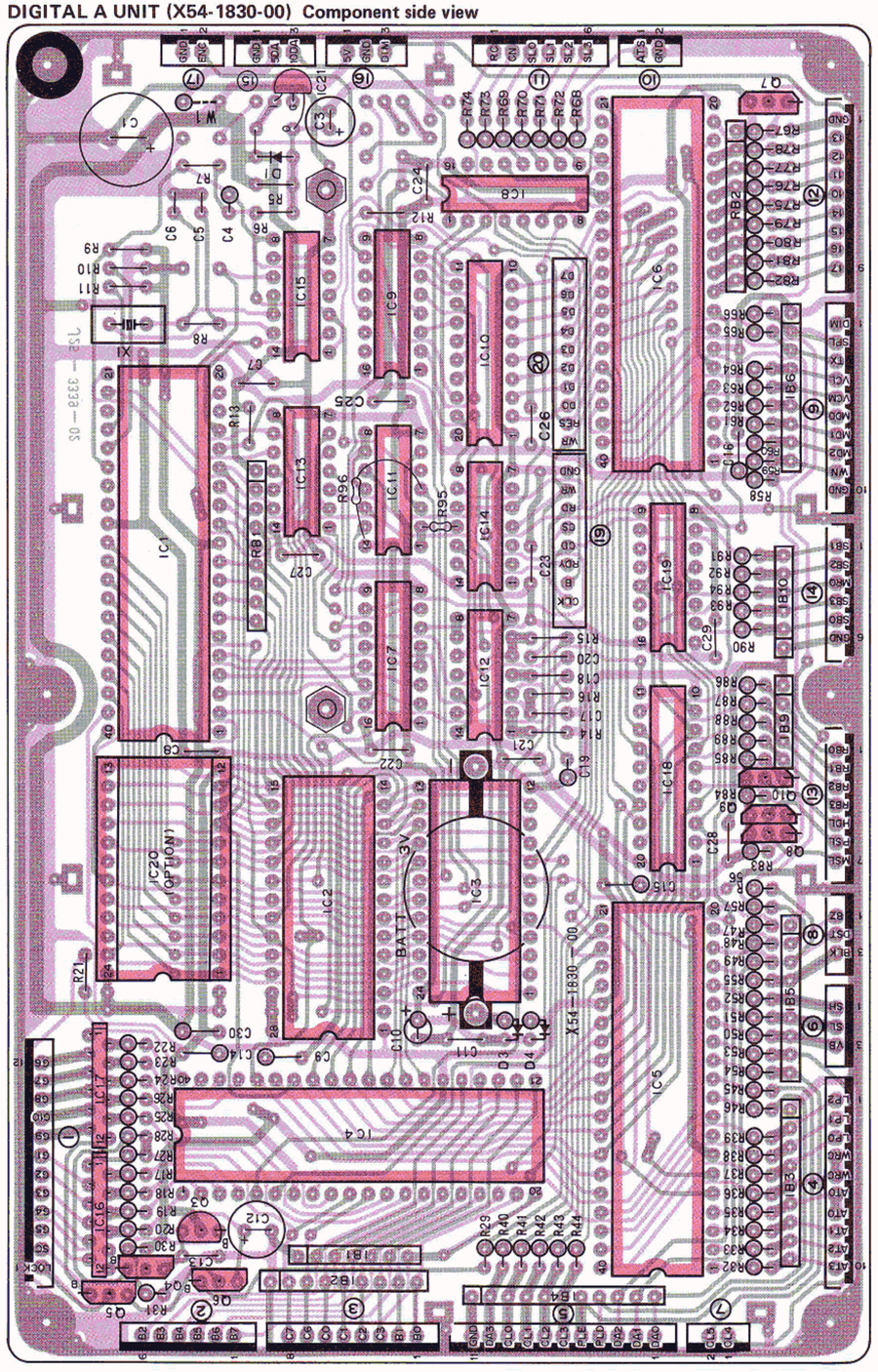

AT UNIT (C) (X57-1130-00) Component side view



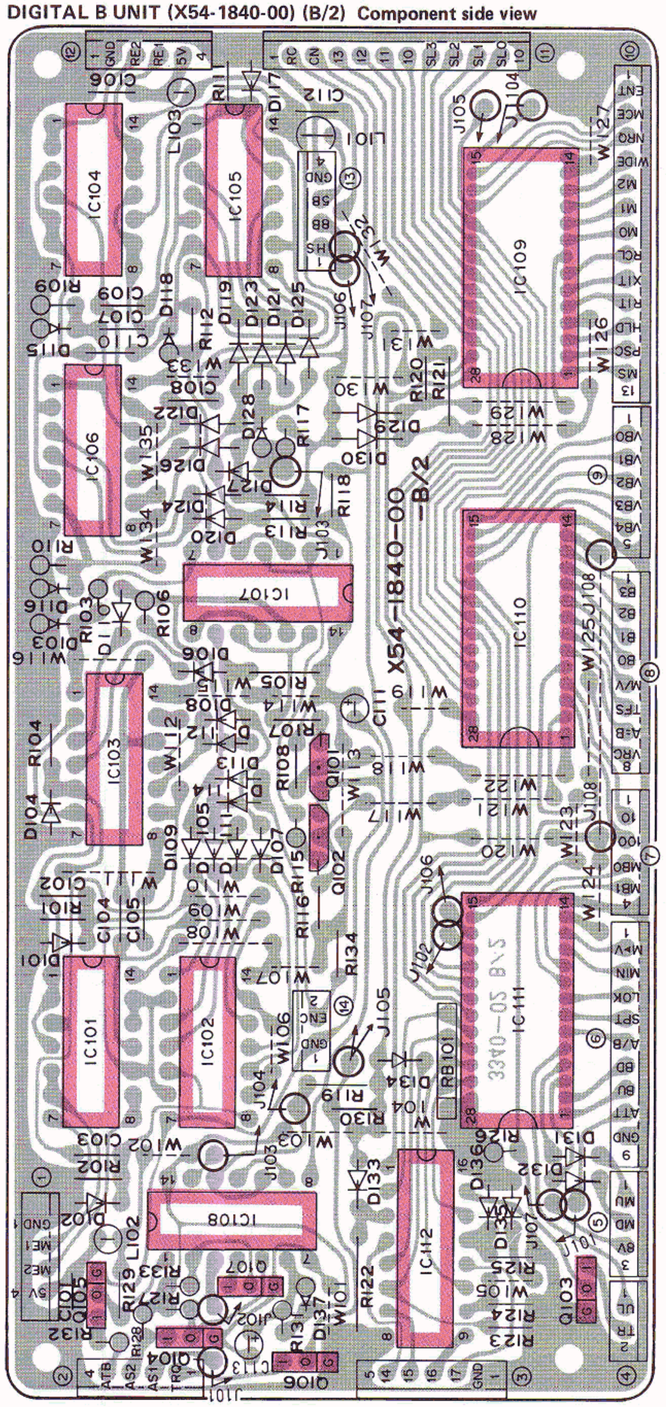
# TS-940S PC BOARD VIEWS

Component side  Foil side

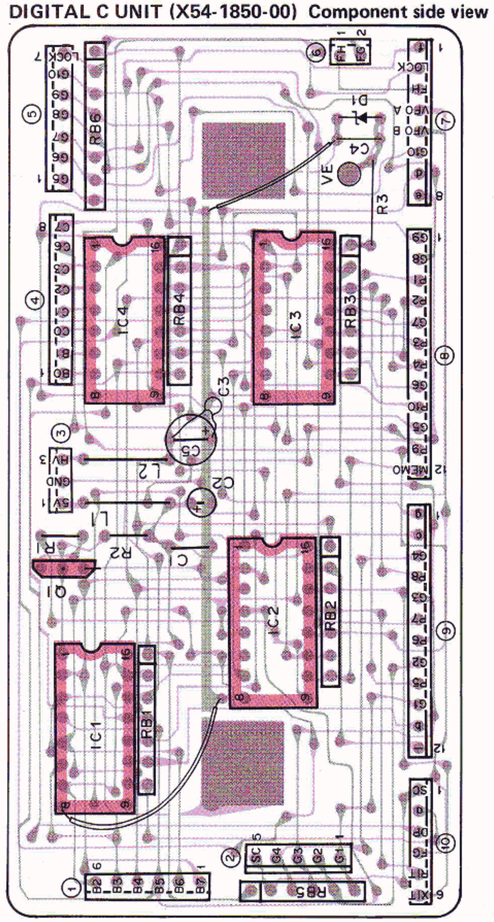
## DIGITAL A UNIT (X54-1830-00) Component side view



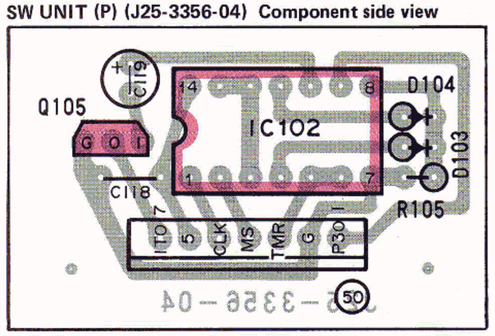
## DIGITAL B UNIT (X54-1840-00) (B/2) Component side view



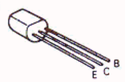
## DIGITAL C UNIT (X54-1850-00) Component side view



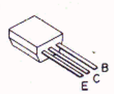
## SW UNIT (P) (J25-3356-04) Component side view



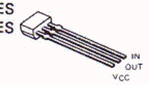
2SC1959



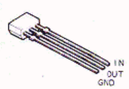
2SA1049
2SC2458



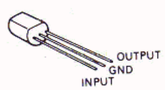
DTA114ES
DTA124ES



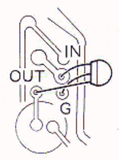
DTC114ES
DTC124ES
DTC144ES



PST518A



DIGITAL A unit
[Attachment direction of IC21]



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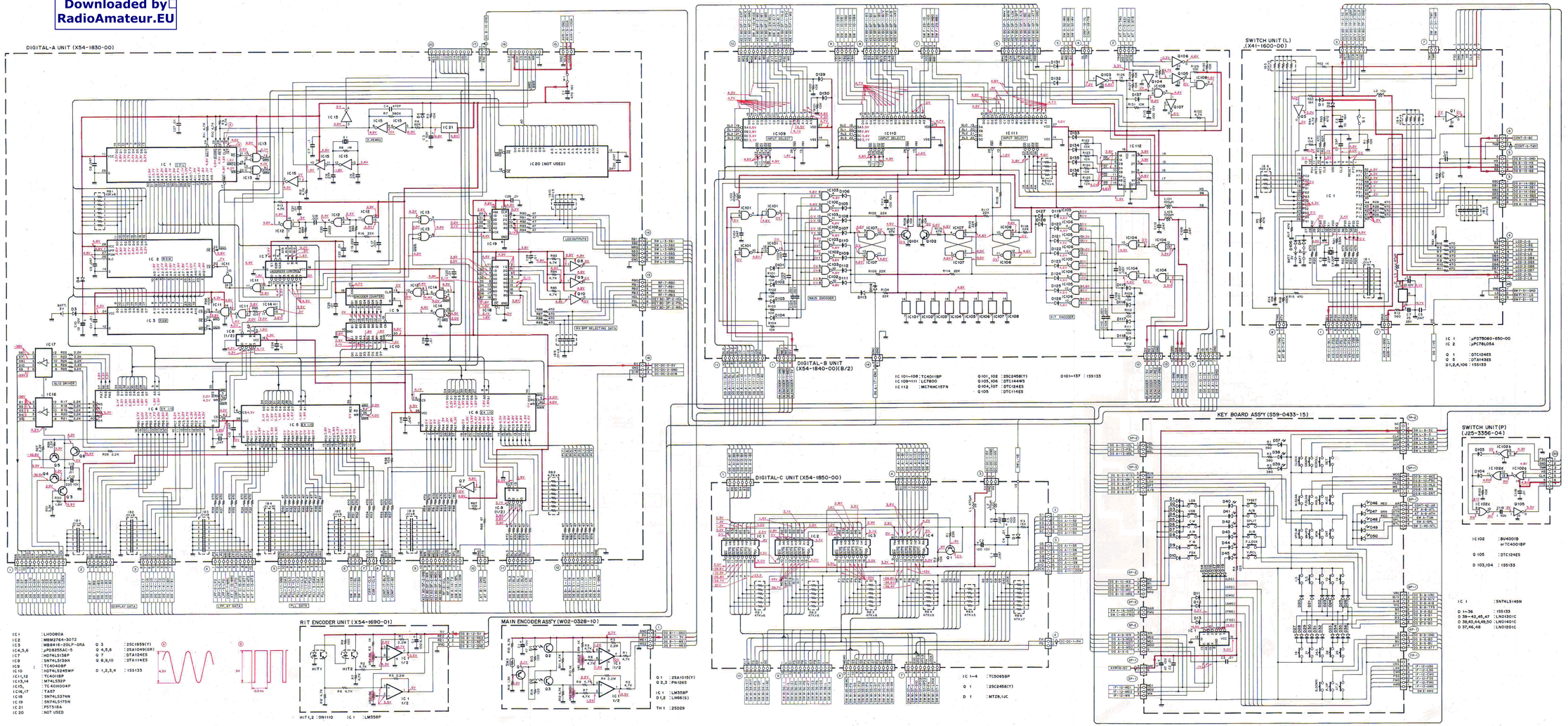
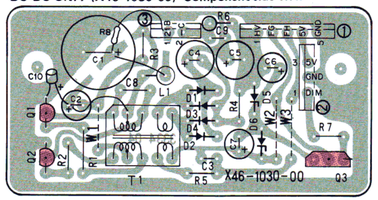
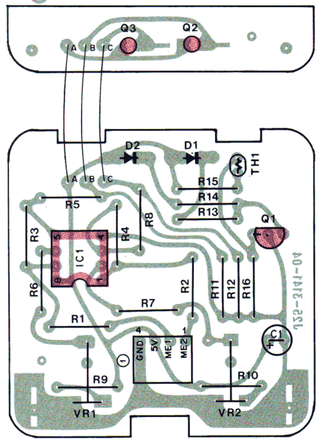


# TS-940S PC BOARD VIEWS

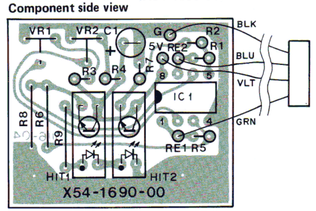
DC-DC UNIT (X46-1030-00) Component side view



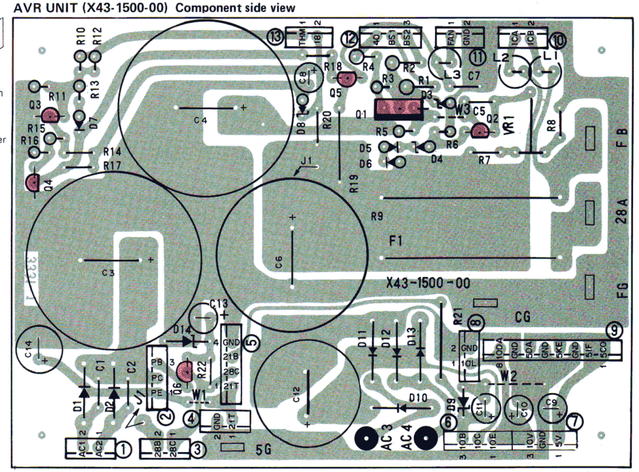

MAIN ENCODER ASS'Y (W02-0328-10)
Component side view



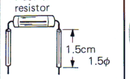
RIT ENCODER UNIT (X54-1690-01)
Component side view



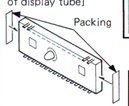

AVR UNIT (X43-1500-00) Component side view



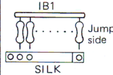

AVR unit
[Attachment method of F1 and R9]



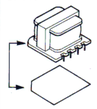

SW unit
[Attachment method of display tube]




SW unit
[Attachment direction of IB1]




DC-DC unit
[Attachment method of T1]



2SA1015
2SC1959
2SC2235
2SC2274K

2SA1048
2SC2458

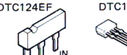
2SB861

PN126S

μPC78L05A

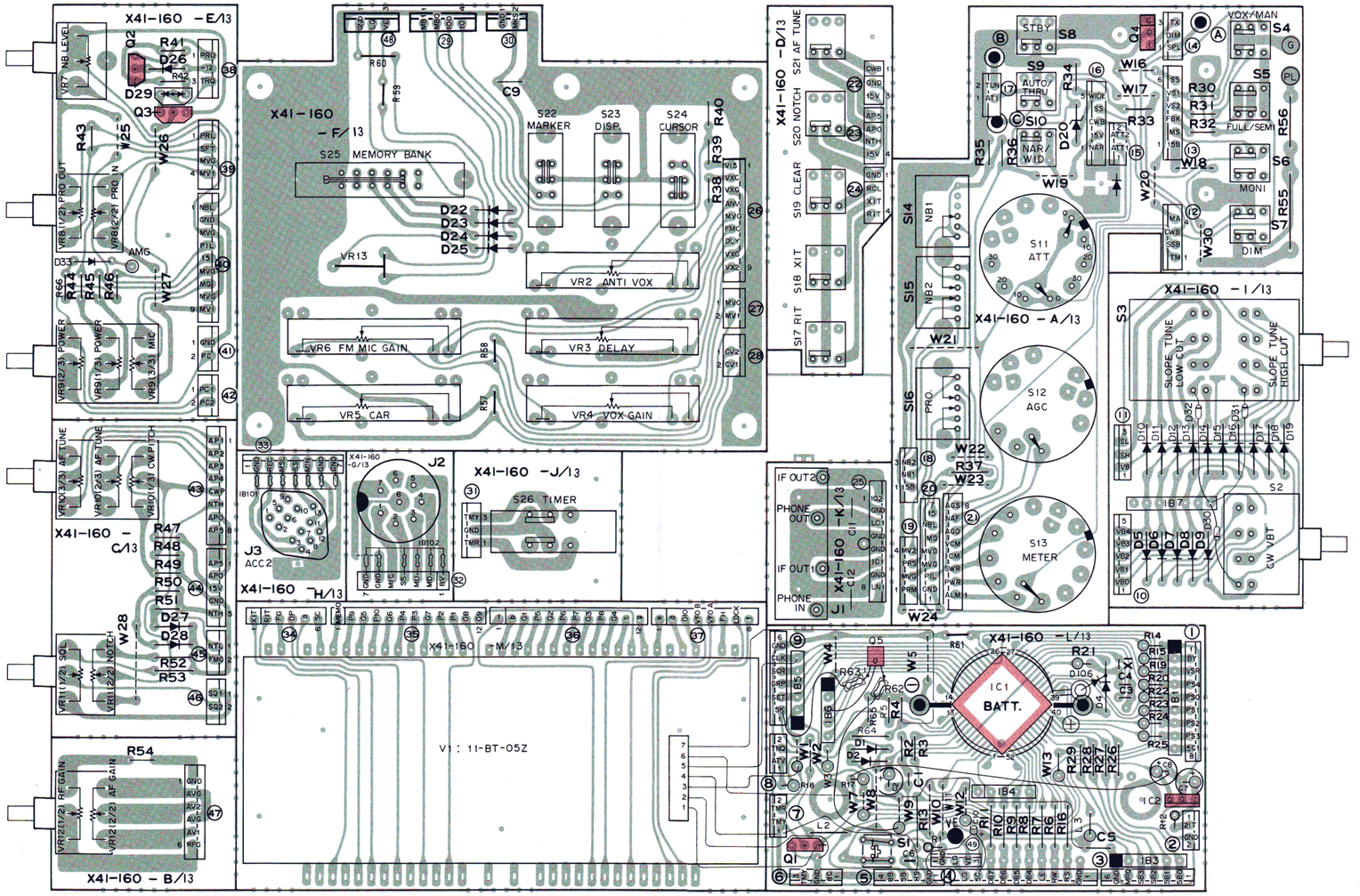
DTA143ES

DTC124EF



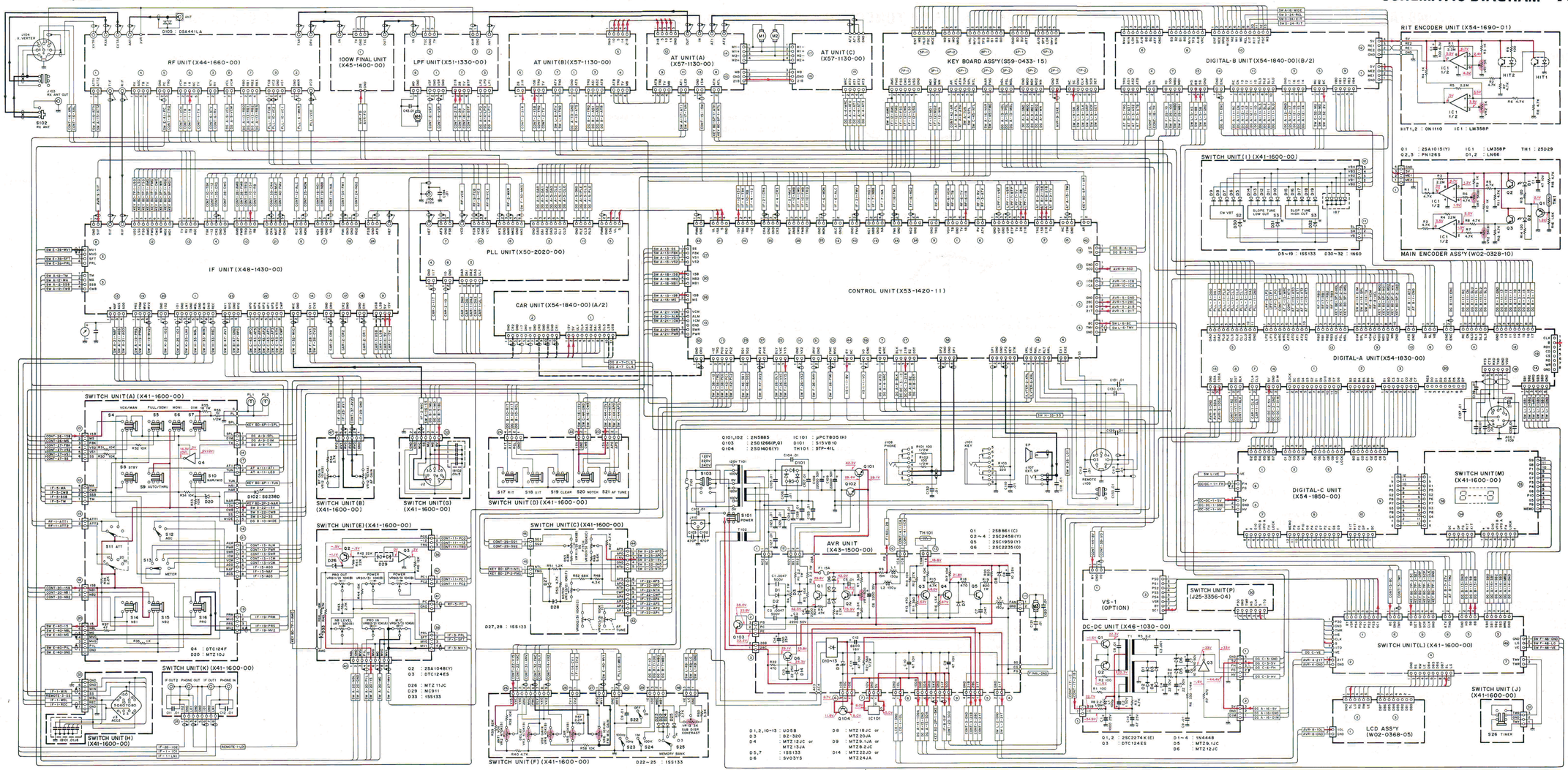

DTC124ES

SW UNIT (X41-1600-00) Component side view



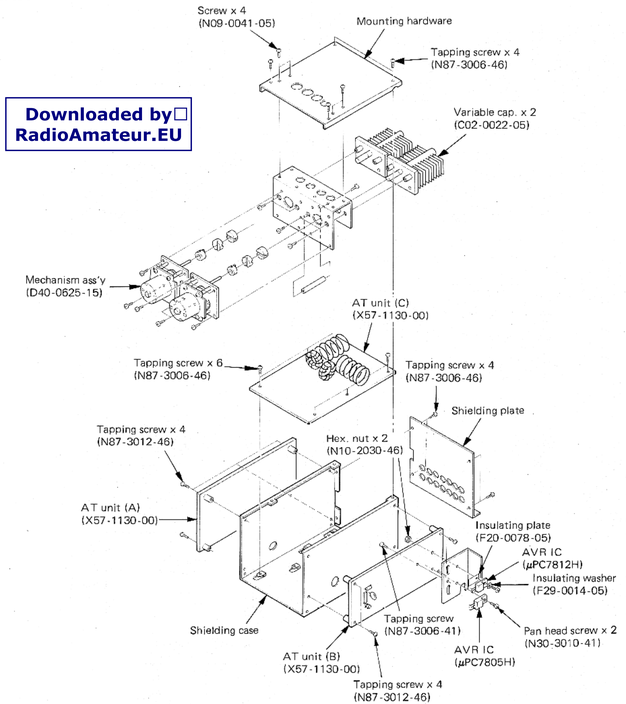
Signal line — Control line — Common DC line

Voltage measurement conditions f=14.150MHz, RX no signal, ( ) : TX.



## AT-940 (ANTENNA TUNER)

### DISASSEMBLY

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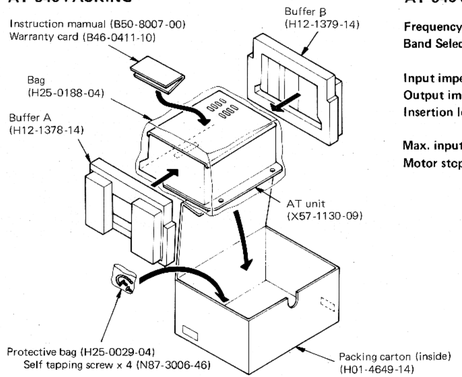
### PARTS LIST

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| B46-0415-00 | * | WARRANTY CARD K | 1 | |
| B50-8007-00 | N | INSTRUCTION MANUAL | 1 | |
| H01-4649-14 | N | CARTON(INSIDE) | 1 | |
| H12-1378-14 | N | BUFFER(A) | 1 | |
| H12-1379-14 | N | BUFFER(B) | 1 | |
| H25-0029-04 | | BAG | 1 | |
| H25-0103-04 | | BAG | 2 | |
| H25-0588-04 | | BAG | 1 | |
| N87-3006-46 | | TAPPING SCREW M3X6 | 4 | |
| N87-3012-46 | | TAPPING SCREW M3X12 | 8 | |
| X57-1130-09 | N* | AT UNIT | 1 | |

## AT-940 (ANTENNA TUNER)/SO-1 (STANDARD OSCILLATOR UNIT)

### AT-940 PACKING




### AT-940 SPECIFICATIONS

| | |
|---|---|
| **Frequency range:** | 1.8–29.7 MHz, all amateur bands |
| **Band Selection:** | Automatic, by band information from the transceiver. |
| **Input impedance:** | 50 ohms, unbalanced |
| **Output impedance:** | 20–150 ohms, unbalanced |
| **Insertion loss:** | Less than 1 dB at 29.7 MHz (at best match) |
| **Max. input power:** | 150W |
| **Motor stop SWR:** | Less than 1.2 |

### SO-1 SPECIFICATIONS

Oscillating frequency . . . . . 20MHz
Frequency stability (long period) . . . . . $\pm 1 \times 10^{-6}$/Year
Temperature stability . . . . . $\pm 5 \times 10^{-7}$ ($-10°C \sim +50°C$)
Adjustable frequency range . . . . . More than ± 60Hz
Output . . . . . More then 0dBm at 50Ω
Weight . . . . . 25g

### SO-1 PARTS LIST

N : New parts

| Parts No. | Re. marks | Description | Ref. No. |
|---|---|---|---|
| B50-3992-00 | N | Instruction manual | |
| H25-0029-04 | | Protective bag | |

### SO-1 ADJUSTMENT

Required f-counter frequency stability (ageing rate) : Better than $2 \times 10^{-8}$/day
The f-counter must be preheated enough before use.

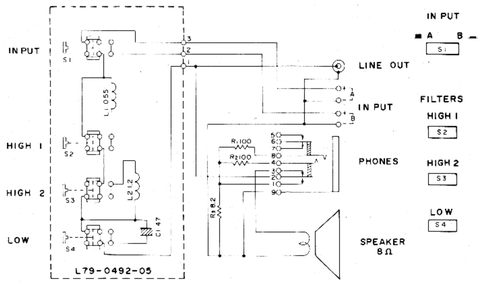
| Item | Condition | Measurement | | | Adjustment | | | Specification/Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Test equipment | Unit | Terminal | Unit | Part | Method | |
| Reference frequency oscillator | 1) FREQ : 10,000.0kHz<br>MODE : USB<br>CAL : ON<br>Connect reference signal output of the f-counter to ANT terminal. | f. counter<br><br>Osillo-scope<br>SP | Rear panel | ANT<br><br>EXT.SP | SO-1 (PLL) | Poten-tiome-ter | Receive reference signal and marker signal, then adjust so that the AF audio signal becomes the same tone. | Oscilloscope wave<br>NG<br>OK |

## SP-940 (SPEAKER)

### SPECIFICATIONS

| | |
|---|---|
| **Speaker used:** | 10 cm dia. |
| **Rated Input:** | 1.5 Watts |
| **Impedance:** | 8Ω |
| **Frequency response:** | 160 Hz to 8kHz. |
| **Filter cut-off frequency,** | |
| **LOW:** | 430Hz, –3dB. |
| **HIGH 1:** | 2.3 kHz, –3dB. |
| **HIGH 2:** | 1.0kHz, –3dB. |
| **HIGH 1 + HIGH 2:** | 730Hz, –3dB. |
| **Filter attenuation:** | –6dB/oct. |
| **Dimensions:** | W 180 mm (7-1/16")<br>H 140 mm (5-1/2")<br>D 288 mm (11-1/3") |
| **Net weight:** | 1.9 kg. (4.2 lbs.) |
| **Accessories furnished:** | Speaker cord, 1pc. (E14-0101-05)<br>1 pin plug, 2 pcs. (E20-1610-05) |

### SCHEMATIC DIAGRAM

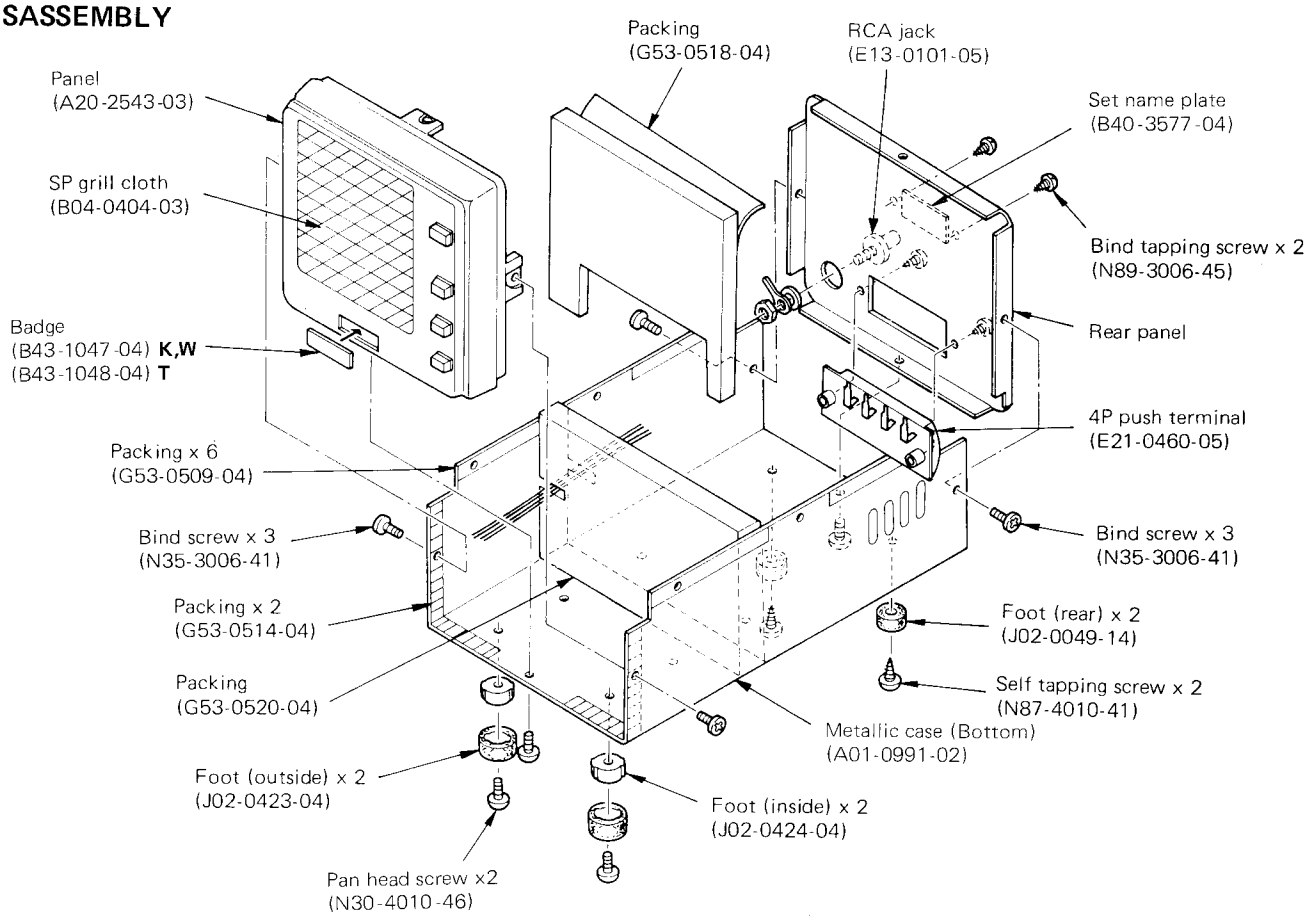



### PARTS LIST

| PARTS NO. | NOTE | NAME & DESCRIPTION | QTY | REFERENCE NO. |
|---|---|---|---|---|
| A01-0990-03 | N* | METALLIC CASE UPPER | 1 | |
| A01-0991-02 | N* | METALLIC CASE BOTTOM | 1 | |
| A20-2543-03 | N* | PANEL | 1 | |
| B04-0404-03 | | SP GRILE | 1 | |
| B40-3577-04 | N* | MODEL NAME PLATE | 1 | |
| B43-1047-04 | N* | BADGE KENWOOD K,W | 1 | |
| B43-1048-04 | N* | BADGE TRIO T | 1 | |
| B46-0431-00 | * | WARRANTY CARD K | 1 | |
| B50-8006-00 | N | INSTRUCTION MANUAL | 1 | |
| CE04BW1E470M | | ELECTRO NONPOLE 47 25V | 1 | C 1 |
| E11-0404-05 | | PHONE JACK | 1 | |
| E13-0101-05 | | RCA JACK LINE OUT | 1 | |
| E14-0101-05 | | RCA PLUG 1P | 1 | |
| E21-0460-05 | N | PUSH TERMINAL 4P | 1 | |
| E30-1711-15 | N | SP CABLE | 1 | |
| E40-0373-05 | | MINI CONNECTOR 3P | 1 | |
| G53-0509-04 | | PACKING | 6 | |
| G53-0514-04 | | PACKING | 2 | |
| G53-0517-04 | N | PACKING | 8 | |
| G53-0518-04 | N | PACKING | 1 | |
| G53-0520-04 | N | PACKING | 1 | |
| H01-4647-04 | | CARTON CASE K,W | 1 | |
| H01-4648-04 | | CARTON CASE T | 1 | |
| H12-0500-03 | | BUFFER | 2 | |
| H20-0276-03 | | PROTECTION COVER | 1 | |
| H25-0049-03 | | BAG | 1 | |
| J02-0049-14 | | FOOT REAR | 2 | |
| J02-0423-04 | | FOOT FRONT(OUT SIDE) | 2 | |
| J02-0424-04 | | FOOT FRONT( IN SIDE) | 2 | |
| J61-0019-05 | | VINYL TIE | 3 | |
| K29-0757-04 | | PUSH KNOB INPUT A/B | 1 | |
| K29-0758-04 | | PUSH KNOB FILTER | 3 | |
| L79-0492-05 | | FILTER | 1 | |
| N30-4010-46 | | PAN HD SCREW M4X10 | 2 | |
| N35-3006-41 | | BIND SCREW M3X6 | 14 | |
| N87-3008-41 | | TAPPING SCREW M3X8 | 4 | |
| N87-4008-46 | | TAPPING SCREW M4X8 | 4 | |
| N87-4010-41 | | TAPPING SCREW M4X10 | 2 | |
| N89-3006-45 | | BIND TAPPING SCREW M3X6 | 2 | |
| N89-3008-45 | | BIND TAPPING SCREW M3X8 | 2 | |
| RS14AB3D8R2J | | METAL FILM 8.2 OHM 2W | 1 | R 3 |
| S40-2436-05 | | PUSH SWITCH | 1 | |
| S42-3405-05 | | PUSH SWITCH | 1 | |
| T07-0222-05 | | SPEAKER | 1 | |

# SP-940 (SPEAKER)

## DISASSEMBLY

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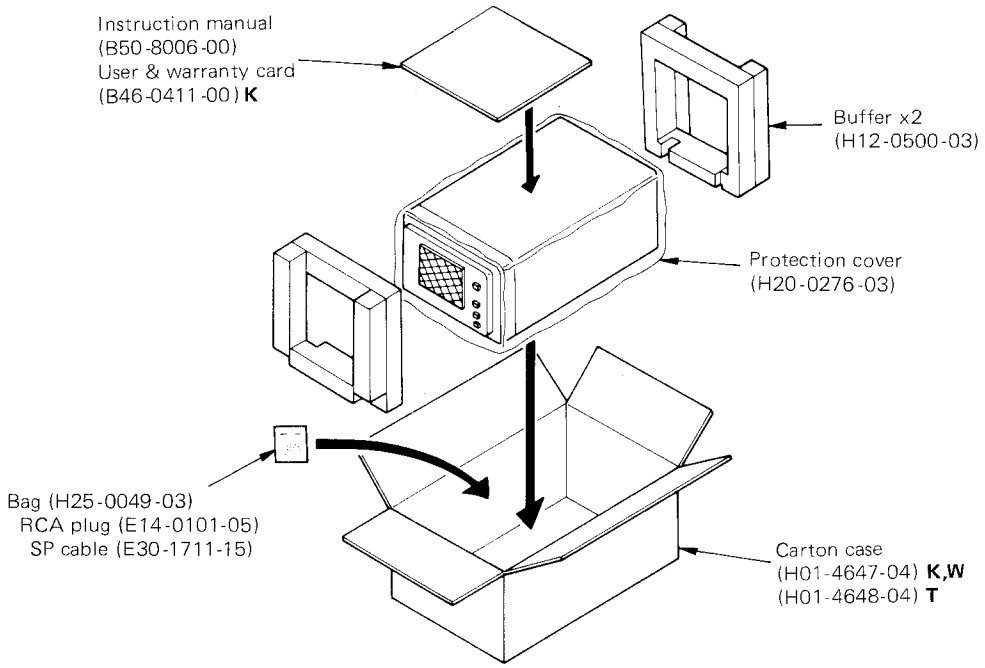
## PACKING



# VS-1 (VOICE SYNTHESIZER UNIT)

## TALK SPEED SELECTION

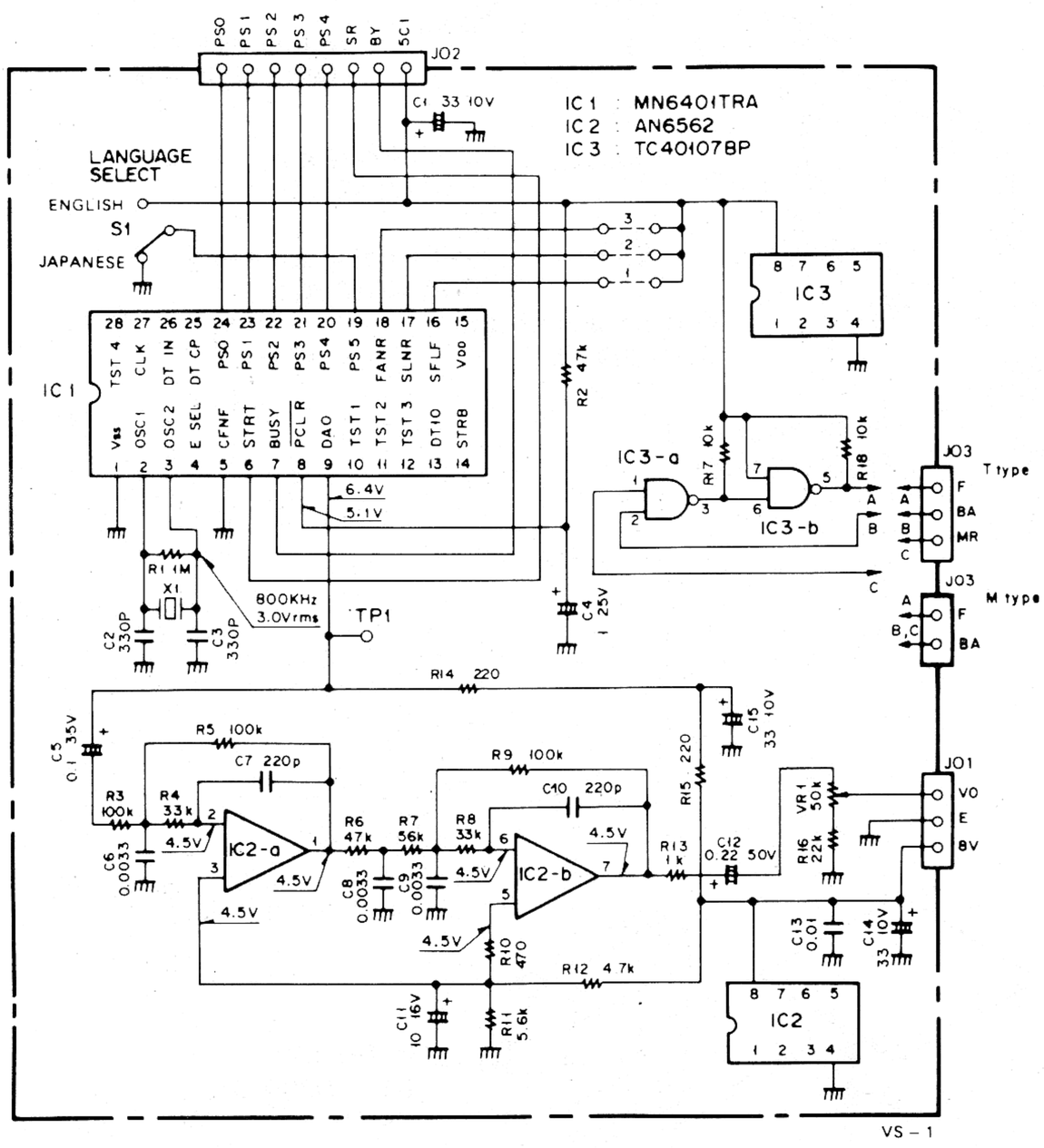
Speed is factory set at "standard" talk speed. Three different speeds can be selected.

**Note:** When placing the jumper, solder carefully.

| Speed / Jumper place | Std. speed | 30% more than Std. | 60% more than Std. |
|---|---|---|---|
| 1 | X | X | O |
| 2 | X | X | O |
| 3 | X | O | X |

Symbol O, denotes the place in which a jumper wire is placed.

## SCHEMATIC DIAGRAM




## PARTS LIST

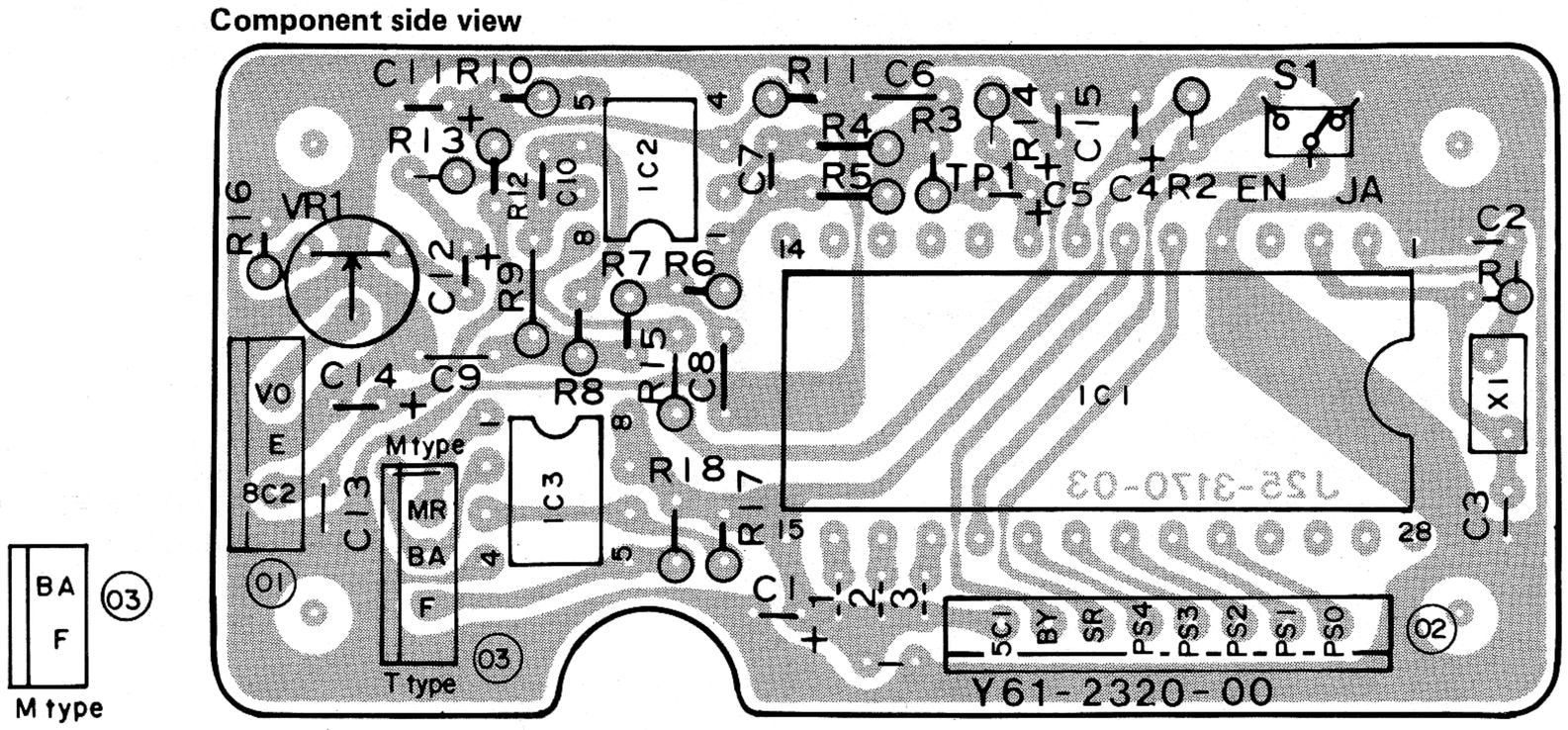
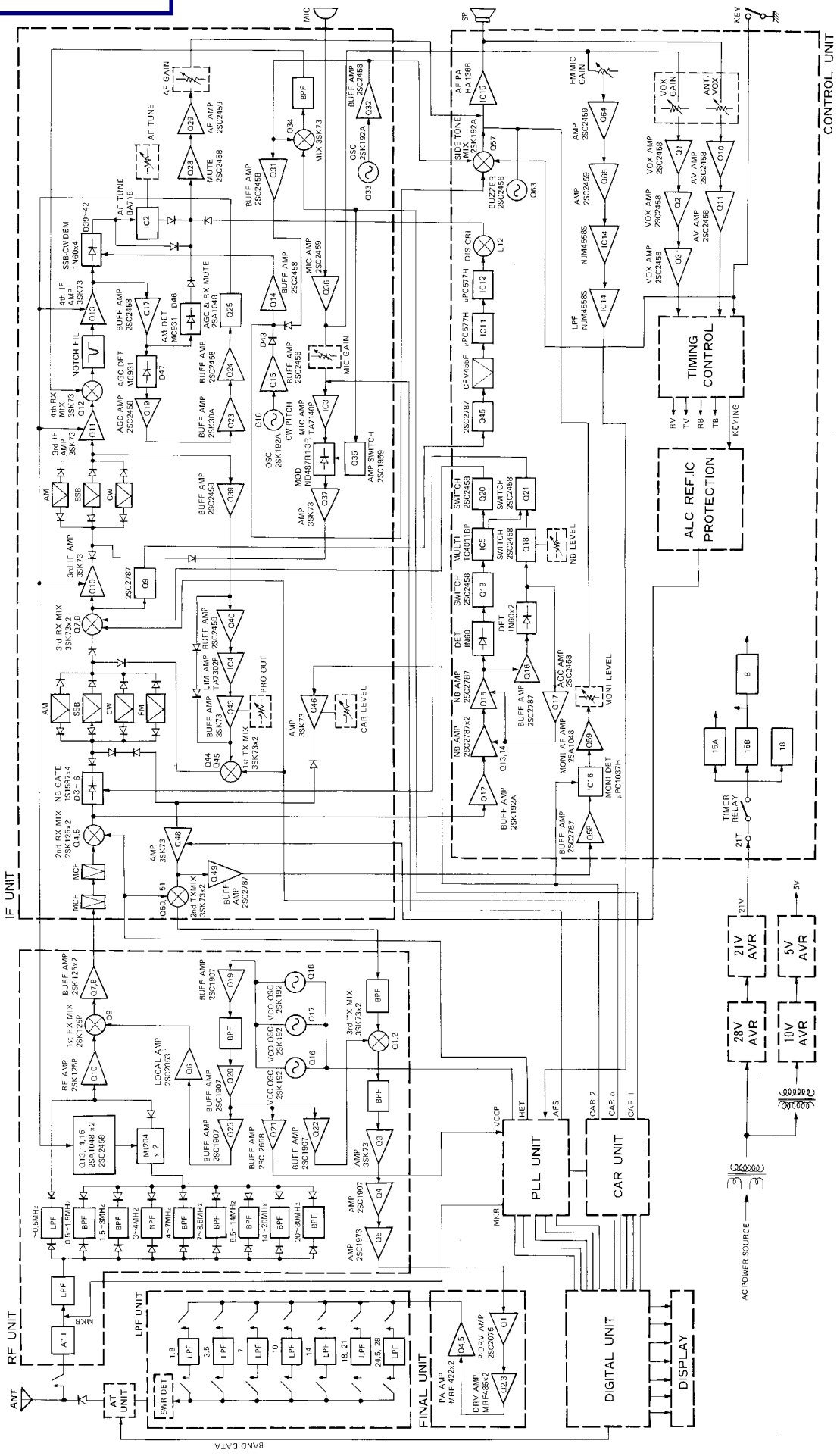
| Part No. | Re-marks | Description | Ref. No. |
|---|---|---|---|
| B50-4035-00 | N | Instruction manual | |
| CC45SL1H331J | | C 330P x 2 | C2,3 |
| CE04W1A330M | | E 33 10V | C1,14,15 |
| CE04W1C100M | | E 10 16V | C11 |
| CE04W1HR22M | | E 0.22 50V | C12 |
| CK45B1H221K | | C 220P x 2 | C7,10 |
| CQ92M1H332K | | ML 0.0033 x 3 | C6,8,9 |
| CS15E1E010M | | T 1 25V | C4 |
| CS15E1V0R1M | | T 0.1 35V | C5 |
| C91-0131-05 | | C 0.01 (SP) | C13 |
| E40-0273-05 | △ | Mini connector 2P **M** | |
| E40-0373-05 | △ | Mini connector 3P **M** | |
| E40-0373-05 | △ | Mini connector x 2 3P **T** | |
| E40-0873-05 | △ | Mini connector 8P | |
| H01-4481-03 | N△ | Packing carton (inside) **M** | |
| H01-4501-03 | N△ | Packing carton (inside) **T** | |
| H25-0029-04 | | Protective bag x 2 | |
| L78-0006-05 | N | Ceramic OSC | X1 |
| N89-3006-46 | | Tapping screw x 4 | |
| R12-4408-05 | | Trim. pot. 50kΩ | VR1 |
| S31-1411-05 | N | Slide switch | S1 |
| AN6562 | N | IC | IC2 |
| MN6401TRA | N | IC | IC1 |
| TC40107BP | N | IC | IC3 |

N : New parts

△ : Please note that these parts are sometimes not in stock and it takes much time to deliver.

## PC BOARD VIEW

**Component side view**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